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ABSTRACT

This guide is designed to provide assistance and support to school districts for the development of a comprehensive K-12 environmental education program. Emphasis is placed on the acquisition of knowledge, attitudes, and skills that would lead to responsible stewardship of the environment. This revised edition provides more in-depth discussion of positive environmental behavior and how to educate toward that end. Infusion of environmental topics into all curricular areas is recommended. Major sections include: (1) an introduction to environmental education plan development (presenting procedures for developing a curriculum plan and characteristics of an ideal plan); (2) rationale and philosophy; (3) goal and subgoals of environmental education program development (including perceptual awareness, knowledge, environmental ethic, citizen action skills, and citizen action experience); (4) theoretical base (discussing developmental theory, behavioral theory, holistic theory, applying research results, and models); (5) how subject areas contribute to environmental education; (6) selecting and developing strategies (addressing classifying educational experiences, helping students develop subgoal skills, dealing with controversial issues, educational technology, and facilities); and (7) evaluation (the purposes of evaluation, evaluation as a continuous activity, and using the results). Appendices include Wisconsin curriculum planning requirements; equity and multicultural education in environmental education; and the Tbilisi Declaration. (LZ)

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A Guide to Curriculum Planning in Environmental Education

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Foreword

The 1985 edition of *A Guide to Curriculum Planning in Environmental Education* was unique in that it was the first and perhaps the only curriculum planning document developed that was based on the internationally developed Tbilisi Declaration. The guide has been widely used in the United States and in more than 40 other countries—by curriculum planners, program developers, universities, and educators seeking a better understanding of environmental education. But shortly after the guide's publication, we recognized that there was a need for a more in-depth discussion of several aspects of environmental education. Since 1985, a large amount of research dealing with positive environmental behavior and how to educate toward that end has been conducted. The Wisconsin Department of Public Instruction has developed this new edition to address growing needs and utilize the new research findings.

This revised edition retains the purpose of the 1985 edition and expands the philosophical base from a global to a universal orientation. The purpose of this guide is to provide assistance and support to school districts in developing comprehensive environmental education programs. The philosophical base includes the ideas that the quality of life and quality of the environment are directly related; every citizen is responsible for maintaining environmental quality; and, because all subject areas contribute to education, all educators share responsibility for preparing citizens to maintain environmental quality.

If we in education are to contribute to establishing an appropriate legacy to pass along to future generations, educators at all grade levels and in every subject area must accept a collective responsibility to prepare students to cherish and help preserve our home—not just the precious planet Earth but the entire universe. We must help students develop an awareness of, and sensitivity to, the environment at all levels, local through universal; help them to understand how the environment functions and how people often create problems as they interact within the environment; and help them to develop the environmental ethic, skills, and commitment they need in order to become effective participants in preventing and resolving environmental problems and issues.

I am confident that Wisconsin educators, and educators everywhere, will, as they have done so remarkably well in recent years, accept this challenge and that together we will soon experience a higher quality environment and, indeed, a higher quality of life for present and future generations everywhere on Earth.

John T. Benson
State Superintendent of Public Instruction

Preface

Wisconsin's historical commitment to environmental education is well-known. Legislation requiring instruction in the conservation of natural resources at both the elementary and secondary level and requiring science and social studies teachers to have "adequate preparation" in the conservation of natural resources was passed during the 1930s. An even greater commitment developed as the environmental movement emerged in the late 1960s and matured through the 1970s. The preface of the 1985 edition of this publication detailed this increased commitment, highlighting Wisconsin's accomplishments through 1983, not the least of which was creating and maintaining the position of environmental education consultant in the Department of Public Instruction (DPI), an action taken by only a very few states.

Since 1983, the people of Wisconsin, through their elected officials, have achieved other important environmental education goals, including:

- publishing and implementing the 1985 edition of *A Guide to Curriculum Planning in Environmental Education*;
- establishing a requirement that every school district develop and implement a written, sequential curriculum plan incorporating instruction in environmental education into all subject area curriculum plans, with the greatest emphasis in plans for art, health, science, and social studies education (see Appendix A);
- creating the Wisconsin Environmental Education Board, consisting of representatives of various state agencies that are responsible for environmental education, the Wisconsin Legislature, and various societal sectors having an interest in or a responsibility for environmental education; and the Wisconsin Center for Environmental Education in the College of Natural Resources of the University of Wisconsin-Stevens Point (see Appendix B).

These efforts brought Wisconsin national and international recognition as an environmental education leader. In 1991 Wisconsin was selected as the recipient of the Institutional Environmental Education Award in the national competition Searching for Success, which is sponsored by the National Environmental Awards Coalition and administered by Renew America, a national clearinghouse of environmental solutions.

Those familiar with the 1985 edition will recognize several changes in the terminology, including the use of the term *subgoal* instead of objective category. The term *perceptual awareness* is used instead of awareness; *environmental ethic* is used instead of attitudes; *citizen action skills* is used instead of skills; and *citizen action experience* is used instead of participation. These changes in terminology were made to better communicate the essence of the ideas they represent.

Acknowledgments

This edition of *A Guide to Curriculum Planning in Environmental Education* is the creation of many people, including numerous educators from Wisconsin and elsewhere. They provided original input as to what this edition should include and critically reviewed section drafts as they were produced. These reviews proved to be invaluable. Those to whom the deepest appreciation is extended include:

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1

Background
The Curriculum Plan
Overview of the Lesson Plans

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Background

The generation now living may very well be that which will make the irrevocable decision whether America will continue for centuries to become the one great nation which had the foresight to preserve an important part of its heritage. If we do not preserve it, then we shall have diminished by just that much the unique privilege of being an American.
—Joseph Wood Krutch

A group of environmental educators from Wisconsin and the nation prepared this publication to assist educators in developing environmental education curriculum plans. Historically, curriculum planning has taken place most often at the classroom level, and the lack of a comprehensive, districtwide plan has resulted in a series of rather inconsistent and unrelated environmental experiences that focus on limited and incomplete program objectives.

A continuous, developmental program of experiences is essential in order for students to acquire perceptual awareness and knowledge, to form attitudes and values, to develop citizen action skills, and eventually to develop a universal environmental ethic that can serve as the basis for positive action for environmental quality. Therefore, a districtwide environmental education curriculum plan must be developed and implemented.

Section 121.02(1), Wis. Stats., requires that every school district develop a written, sequential K-12 environmental education plan. Wisconsin Administrative Code PI 8.01(2)(k)(2) defines the nature of this plan (see Appendix A).

A district's environmental education curriculum plan should include the following elements:

- a statement of the district's philosophy and policies related to environmental education;
- a statement of goals and subgoals;
- a curriculum framework of objectives organized in a developmental sequence with subject areas contributing to and responsible for their achievement identified;
- subject area activities that contribute to the achievement of each objective; and
- procedures for assessing the plan and its implementation.

Like all district curriculum plans, the plan for environmental education should never be considered complete. It must be monitored continuously and modified over time.

Procedures for Developing a Curriculum Plan

To be most effective and efficient, the development and implementation of an environmental education curriculum plan should follow a series of steps.

Step 1: Form a Districtwide Environmental Education Committee

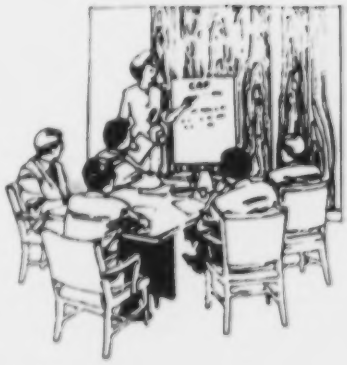
Ideally, this committee should include representatives from all groups affected by the program: administrators; teachers from various grade

levels; teachers representing most subject areas, but especially art, health, communication arts, science, and social studies; school board members; students; and community citizens. In many school districts, particularly in small ones, it may be difficult to find representation from all of these areas but doing so will establish the commitment of the represented groups and provide credibility for the program. The committee should be large enough to represent the interested parties, yet small enough to work effectively as a unit.

A person with both leadership ability and an understanding of the environment and environmental education should lead the committee. This position will be time-consuming, thus release from other assignments is very important, especially when committee activity is at its highest levels.

Step 2: Prepare the Committee

Members of the committee need to fully understand what is contained in this publication, so they must study it and thoroughly discuss its contents. Consultation with the Department of Public Instruction, the Department of Natural Resources, or a college or university, especially the Wisconsin Center for Environmental Education at the University of Wisconsin-Stevens Point (see Appendix B), may be useful in developing this understanding. Once committee members have reached a satisfactory level of understanding, they can begin identifying and scheduling the tasks to be completed. It is important that a realistic time line be established for the development process, recognizing both time and budgetary constraints.



Man is a prisoner of his own way of thinking and his own stereotype of himself. His machine for thinking, the brain, has been programmed to deal with a vanished world.
—Stafford Beer

Step 3: Develop a Philosophy

The committee should develop a philosophy statement regarding environmental education that reflects the district's overall educational philosophy. The philosophy statement on page 11 of this guide may be of assistance in completing this task.

Step 4: Conduct a Needs Assessment

The committee should attempt to determine the existing status of environmental education in the district. This may involve asking teachers to report on how and what they are teaching about the environment. It may involve testing students and teachers on what they know about the environment and environmental issues and problems. If an adequate understanding of the existing status of the program can be ascertained, the easier it will be to determine what needs to be done to develop and implement an outstanding curriculum.

Step 5: Establish Goals

When the needs assessment has been completed, the committee should be ready to develop a statement of goals. This statement should

relate directly to the needs identified by the assessment process and to the philosophy statement developed under Step 3. The goal and subgoal statements in section 3 are recommended as a guide. When completed, the philosophy and goal statements should be submitted to the district administrator and school board for approval.

Step 6: Develop a Curricular Framework

Developing a curricular framework for environmental education will be a major challenge for the committee. The objectives that constitute the framework should be organized into a developmental sequence. Although they will be identified in the framework as environmental education objectives, some also will be objectives of a particular subject area, and some will be environmental education objectives to be achieved concurrently with specific subject area objectives. Ideally, the environmental education committee should develop a tentative framework of environmental education objectives and then work directly with each subject area committee to ensure that there is agreement between the environmental education and subject area plans. This is the major reason why members of the environmental education committee should represent as many subject areas and grade levels as possible.

When it comes to nature study, natural sciences, and environmental education, we are really dealing with a huge percentage of teachers who do not have any kind of background in the subject matter.
—Marshall Case, National Audubon Society Vice President for Education

The models at the end of section 4 and the discussion of subject area contributions in section 5 will help the committees develop the curricular framework. Most curricular frameworks are primarily based on knowledge, which is one of the five subgoals of environmental education. Thus, committee members must be careful not to emphasize that subgoal at the expense of others. Perceptual awareness, environmental ethic, citizen action skills, and citizen action experience must be considered to be equally important subgoals.

When the environmental education framework is completed to the satisfaction of all committee members, they should indicate which subject areas are responsible for achieving each objective. Likewise, objectives in each subject-area plan should identify associated environmental education objectives.

Step 7: Prepare Staff Members

When the curricular framework is completed, district staff members who will deliver the curriculum plan to students should identify and implement the instructional strategies to be used in attaining each objective. If staff members determine instructional strategies, they will be more willing to accept and implement the parts of the plan assigned to them. But before doing so, they must gain a minimum level of expertise in environmental education.

At a minimum, the environmental education committee should help other staff members understand the district philosophy statement, the goals/subgoals statement, the elements of the curricular framework with which they will work, and the processes for identifying the environmental content of their particular subject area.

The committee also should help other staff members identify those elements of the existing curriculum that are environmental education. This may be accomplished by interacting with individuals or using a survey to be completed by each staff member. This latter approach is best undertaken after staff members have developed an understanding of the district philosophy, goals, and curricular framework.

Step 8: Provide Additional Inservice Preparation

Staff members may benefit from additional inservice preparation in content and methodology dealing with environmental education. The Wisconsin Administrative Code PI 3.05(4) (see Appendix C) identifies seven competencies that must be demonstrated by those candidates seeking certification to teach in the areas of early childhood, elementary, agriculture, science, and social studies education. Four of these competencies are content-oriented, three deal with methodology. Staff members who are deficient in these competencies would benefit greatly from inservice workshops or university courses. The district committee should assess the need for staff training and arrange for needed workshops or courses.

. . . How can I create a psychological climate in which that child will feel free to be curious, will feel free to make mistakes, will feel free to learn from the environment, from fellow students, from me, from experience? How can I help him recapture the excitement of learning that was natural in infancy?
—Carl Rogers

Step 9: Develop Instructional Strategies

Teachers are primarily responsible for developing the instructional strategies that help achieve the objectives established as part of the curricular framework, but the district committee should be ready to assist staff members in this process. Section 6 of this guide suggests how appropriate instructional activities might be identified and developed.

As staff members develop instructional strategies, they should identify equipment and materials needed to implement the strategies. The district committee should complete a master list of materials and equipment to help develop budget requests. Field trips and other extra-classroom activities should be identified and their costs should be included in budget requests.

It is at this phase in curriculum planning that all staff members should be alert to the need for equity in the activities they develop and in the equipment and materials they identify for use in implementing them. "Equity and Multicultural Considerations in Environmental Education" (Appendix D) should be understood and applied in completing this step in curriculum planning.

Step 10: Develop and Implement an Evaluation Plan

Evaluation is a fundamental and continuing aspect of any effective educational program. Monitoring is a form of continuous evaluation that incrementally determines progress in program development and

implementation. Section 7 is devoted to the evaluation of environmental education programs. It is the district committee's responsibility to carry out this activity.

Characteristics of an Ideal Plan

The characteristics of an ideal K-12 environmental education curriculum are described in the following sections. An ideal curriculum, and the program through which it is implemented is

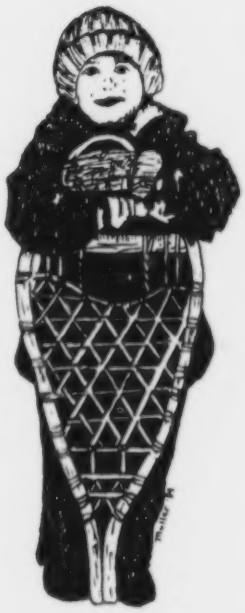
- learner-focused, based on the known developmental characteristics of learners in grades K-12;
- holistic, considering natural, built, technological, and social environments, where the latter category encompasses economic, political, cultural, ethical, and aesthetic aspects;
- universally oriented, not only for the ecosystem of Earth, but for the entire universe;
- future-oriented, demonstrating concern not only for the present inhabitants of Earth, but for future inhabitants as well;
- issue-oriented, examining issues through all perspectives—local, state, regional, national, international, and universal;
- action-oriented, directly involving participants in the resolution of problems and issues;
- continuous, serving students in all subject areas at all grade levels;
- interdisciplinary, drawing its content from all disciplines; and
- experientially oriented, employing a diverse array of learning environments and instructional approaches, utilizing direct experiences whenever possible.

This list of characteristics was used to develop Appendix E, "A Planning Checklist for a School District Environmental Education Program." It may be used by a school district's environmental education committee as a means of identifying the tasks that must be completed in developing a curriculum plan. And when the plan has been completed, it may be used to determine if all important elements have been included.

2

Rationale

As long as nature is seen as in some way outside us, frontiered and foreign, separate, it is lost both to us and in us.
—John Fowles



Earth, one of the smaller planets, hurtles through space on a relatively fixed course. As it does, its life-support system, sustained by energy from the sun, recycles chemicals that provide water, air, and food to all its living inhabitants. Its crust contains a finite supply of fossil fuels, metals, and other nonrenewable resources. The human inhabitants of Earth have made remarkable technological progress in extracting these resources and using them for their own benefit, but in doing so major problems have arisen. The World Commission on Environment and Development, created by the United Nations in 1982, stated in its 1987 report, *Our Common Future*:

"Scientists bring to our attention urgent but complex problems bearing on our very survival: a warming globe, threats to the Earth's ozone layer, deserts consuming agricultural land. We respond by demanding more details, and by assigning the problems to institutions ill-equipped to cope with them. Environmental degradation, first seen as mainly a problem of rich nations and a side effect of industrial wealth, has become a survival issue for developing nations. It is part of the downward spiral of linked ecological and economic decline in which many of the poorest nations are trapped. Despite official hope expressed on all sides, no trends identifiable today, no programs or policies, offer any real hope of narrowing the growing gap between rich and poor nations."

It states further that:

"The environment does not exist as a sphere separate from human actions, ambitions, and needs, and attempts to defend it in isolation from human concerns have given the very word 'environment' a connotation of naivety in some political circles. The word 'development' has also been narrowed by some into a very limited focus, along the lines of 'what poor nations should do to become richer,' and thus again is automatically dismissed by many in the international arena as being a concern of specialists, of those involved in questions of 'development assistance.'

"But the 'environment' is where we all live; and 'development' is what we all do in attempting to improve our lot within that abode. The two are inseparable. Further, development issues must be seen as crucial by the political leaders who feel that their countries have reached a plateau toward which other nations must strive. Many of the development paths of the industrialized nations are clearly unsustainable. And the development decisions of these countries, because of their great economic and political power, will have a profound effect upon the ability of all peoples to sustain human progress for generations to come."

This report concludes that the only solution to this crisis is sustainable development, development that "seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future."

Fritjof Capra, founder of the Elmwood Institute, in an opinion column in the January-February 1990 issue of *The Futurist* (published by the World Future Society), questioned why the inseparable nature of environment and development is not understood. He concluded that:

"The more we study the major problems of our time, the more we come to realize that they cannot be understood in isolation. They are systemic problems—interconnected and interdependent. Stabilizing world population will be possible only when poverty is reduced worldwide. The extinction of animals and plant species on a massive scale will continue as long as the Third World is burdened by massive debts. Only if we stop the international arms race will we have the resources to prevent the destruction of both the environment and human life—the flooding of coastal cities caused by global warming, large-scale loss of cropland with ensuing malnutrition and famine, and so on.

"Ultimately, all these problems are facets of one single crisis, which is essentially a crisis of perception. We are at the beginning of a change of world view as radical as the Copernican Revolution—a shift from a mechanistic to a holistic and ecological view, from a value system based on domination to one based on partnership."

Capra concludes his statement by saying:

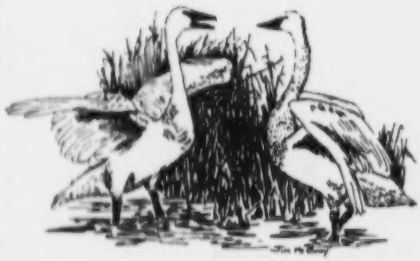
"Confined by the narrow framework of the mechanistic world view, too many 'leaders' continue the fragmented approach that has become so characteristic of businesses, academic disciplines, and government agencies. Such an approach can never solve any of the problems but merely shifts them around erratically. One year it's inflation, then it's drugs and crime, then the greenhouse effect, and so on. But the underlying problem, never addressed, is always the same problem in different guises—the same crisis of perception.

"Not only do our leaders fail to see how different problems are interrelated, they also refuse to recognize how their so-called solutions affect future generations. They don't seem to be concerned if species disappear at the rate of one a day or if current prosperity is based on borrowing from the future, both in terms of money and nonrenewable resources, as long as they can claim in their next election speech or quarterly report that jobs have been 'saved.'

"From the systemic, ecological point of view, the only workable solutions are those that are sustainable."

In a democratic republic such as the United States, decisions made by government leaders—the decisions about the issues referred to in the preceding statements—are ultimately the decisions of citizens. For citizens to be able to effectively participate in decision-making processes with their leaders, they must understand how environmental, economic, and social systems function; realize that environmental, economic development, and social issues are inseparable; and recognize that opportunities to participate exist. A major function of education is to help citizens do these things. Robert Theobald's statement from his 1970 book, *An Alternative Future for America II*, still holds true today:

The beauty and genius of a work of art may be reconceived, though its first material expression be destroyed; a vanished harmony may yet again inspire the composer; but when the last of a race of living things breathes no more, another heaven and another earth must pass before such a one can be again.
—William Beebe



"We can all continue to say we are only churchmen, or only educators, or only students, or only government people—that our role is limited, and that we cannot be expected to solve the problems of the world. But . . . some of us had better choose to define ourselves as world problem solvers if world problems are going to be solved."

The preparation of world problem solvers, actually universal problem solvers, is a proper role not only for environmental education, but all education.

Education in environmental matters, for the younger generation as well as adults, giving due consideration to the underprivileged, is essential in order to broaden the basis for an enlightened opinion and responsible conduct by individuals, enterprises, and communities in protecting and improving the environment in its full human dimension.
—Recommendation No. 19, United Nations Conference on the Human Environment, 1972

This role for education has been accepted globally, and in virtually every country there is a frantic haste to develop programs in environmental education. The genesis of this movement was the 1972 United Nations Conference on the Human Environment which recommended that every nation promote the development of such programs. In 1977, following a series of international conferences and workshops sponsored by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and the United Nations Environmental Programme (UNEP), an official statement on environmental education, the Tbilisi Declaration (Appendix F), was released. It provides a rationale, goals, objective categories, and guiding principles for environmental education. More recently, in June 1992, the United Nations Conference on Environment and Development (UNCED) was held in Rio de Janeiro, Brazil. By consensus, the conference adopted *Agenda 21*, an 800-page action plan for the twenty-first century. Section IV, Chapter 4 of that document states: "The declaration and recommendations of the Tbilisi Conference on Environmental Education, organized by UNESCO and UNEP and held in 1977, have provided the fundamental principles for the proposals . . . (of UNCED)."

The document further describes three program areas.

- reorienting education toward sustainable development
- increasing public awareness
- promoting training

The document then outlines two important objectives for reorienting education toward sustainable development.

- to strive to achieve the accessibility of environmental and development education, linked to social education, from primary school age through adulthood to all groups of people; and
- to promote integration of environment concepts, including demography, in all education programs, in particular the analysis of the causes of major environmental and development issues in a local context, drawing on the best available scientific evidence and other appropriate sources of knowledge, and giving special emphasis to the further training of decision makers at all levels.

The Tbilisi Declaration provided the philosophical base for the 1985 edition of this publication. It continues to do so for this revised edition, with additional support from *Agenda 21*.

Philosophy

We believe that education must work to help each student develop an awareness of, and a sensitivity to, the environment and its problems; acquire knowledge and understanding about how the environment works; foster an environmental ethic on which to base patterns of conduct toward the environment; and develop the skills needed to effectively discharge the responsibilities of citizenship in improving and protecting the environment at all levels—local, national, global, and universal.

We further believe that in doing so, education must consider all aspects of the environment—natural, built, technological, and social (economic, political, cultural, historical, ethical, and aesthetic)—and acknowledge their interdependence, emphasizing an enduring continuity linking actions of today to consequences for tomorrow and the need to think in universal terms.

We also believe that to accomplish this, environmental education must be continuous, must pervade all subject areas at all grade levels, and must offer students experiences as concrete and direct as possible, involving them in investigating real environmental issues and problems in their own community from a position of neutrality, with no position being advanced in favor of another.

In short, we believe that environmental education must help students develop a universal environmental ethic—a sense of responsibility and commitment to the future—which prepares them to carry out the role of defending and improving the environment, in order to sustain both present and future generations of all living things.

If humankind adopts the ethics of belonging to the earth, then it will indeed belong. It will fit in; it will be fit; it will survive. If on the other hand it does not adapt this sense of belonging, then not-belonging to will 'come true': humanity will inevitably pollute, breed, or explode itself out of existence. It will have proven maladapted, failed the test for survival.
—David Oates

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3

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The usual answer to this dilemma is 'more conservation education.' No one will debate this, but is it certain that only the volume *of education needs stepping up? Is something lacking in the content as well?*
—Aldo Leopold

The need to develop educational programs that enable student citizens to acquire a universal environmental ethic has been recognized both nationally and internationally. Such an ethic, it is believed, would result in adult citizens working to prevent and resolve environmental problems and issues, thereby ensuring a sustainable future for all of Earth's inhabitants. Programs of this type should be developed with the following goal in mind.

The goal of environmental education is to help students become environmentally aware, knowledgeable, skilled, dedicated citizens who are committed to work, individually and collectively, to defend, improve, and sustain the quality of the environment on behalf of present and future generations of all living things.

Five subgoals may be extracted from this goal statement.

Perceptual Awareness: To help students develop the ability to perceive and discriminate among stimuli; to process, refine, and extend those perceptions; and to concurrently acquire an aesthetic sensitivity to both natural and built environments.

Knowledge: To help students acquire a basic understanding of how the natural environment functions, how its functioning is affected by human activity, and how harmony between human activity and the natural environment may be achieved.

Environmental Ethic: To help students develop a universal ethic on which they may act to defend, improve, and sustain the quality of the environment.

Citizen Action Skills: To help students develop the skills needed to identify, investigate, and take action toward the prevention and resolution of environmental issues.

Citizen Action Experience: To help students gain experience in applying acquired perceptual awareness, knowledge, an environmental ethic, and citizen action skills in working toward the prevention and resolution of environmental issues at all levels, local through universal.

Subgoal: Perceptual Awareness

To help students develop the ability to perceive and discriminate among stimuli; to process, refine, and extend those perceptions; and to concurrently acquire an aesthetic sensitivity to both natural and built environments.

Perceptual awareness develops when a stimulus, a sensory input from outside the body, is combined with thoughts and feelings inside the body to produce meaning. A program planned to help students develop a perceptual awareness encompasses much of receiving and responding,

the two lowest levels of the Taxonomy of Educational Objectives: Affective Domain (Figure 1).

Figure 1

Taxonomy of Educational Objectives: Affective Domain

Reprinted with permission from *Taxonomy of Educational Objectives: The Classification of Educational Goals: Handbook II: Affective Domain* by David R. Krathwohl, Benjamin S. Bloom, and Bertram B. Masia. New York: David McKay Co., Inc., 1964.

1.0 Receiving (Attending)
- 1.1 Awareness
- 1.2 Willingness to receive
- 1.3 Controlled or selective attention

2.0 Responding
- 2.1 Acquiescence in responding
- 2.2 Willingness to respond
- 2.3 Satisfaction in response

Thus perceptual awareness may be regarded as affective in nature, but it is almost a cognitive behavior. It differs from knowledge, the lowest level of the Taxonomy of Educational Objectives: Cognitive Domain, in that the concern is not for the learner to recall an item or fact, but to be conscious of something. At its very lowest level, perceptual awareness means that the learner is conscious of an object, phenomenon, or event in the environment, but recognition of the characteristics of these environmental elements may be almost entirely lacking. At a higher level of perceptual awareness the learner recognizes many characteristics of environmental elements. For example, at the lowest level the learner may be conscious of wild flowers in a natural environment or of buildings in a built environment. At a higher level the student may recognize color, shapes, heights, and other details of wild flowers or architectural details of buildings.

Figure 2 defines the process skills that are acquired as perceptual awareness develops. The illustrative learner outcomes in Figure 2 result when students are allowed to make maximum use of their senses in perceiving and discriminating among environmental stimuli and in processing, refining, and extending those perceptions. There is no sharp line between perceiving and discriminating among stimuli and processing, refining, and extending those perceptions. They occur almost concurrently; as soon as a stimulus is received, its processing begins.

. . . Education is, not entirely, nor even mainly, an affair of book learning, for that is only education of one part of our nature—the part of the mind that deals with concepts and abstractions. In the child, who is not yet mature enough to think by these shortcut methods, it should be largely an education of the senses—the senses of sight, touch and hearing. In one word, the education of the sensibility.
—Herbert Read

Figure 2

Developing Perceptual Awareness

Perceiving and Discriminating among Stimuli

Process Skill	Illustrative Learner Outcomes
Observing: Using one or more of the senses to determine the attributes of an object or an event in the environment.	Students will be able to • use their sense of sight to determine the color of natural and human-made objects. • use their sense of touch and sight to determine the texture of natural and human-made objects. • use their sense of sight to identify those objects that are of a particular shape (for example, square) and of a particular color (for example, red). • use their sense of smell to identify objects that smell sweet. • use their sense of taste to identify whether substances taste bitter, sweet, or salty. • use their sense of hearing to differentiate between sounds (for example, a train whistle and an automobile horn). • use several senses (for example, to describe a grape as being green, small, round, smooth, cool, and sweet).
Classifying: Grouping objects, ideas, or events according to criteria based on observed similarities and differences.	Students will be able to • organize a set of objects into subsets with a common characteristic (for example, all blue or all red) and to further organize these subsets into groups with a second common characteristic (for example, all rough, red; all smooth, red; all rough, blue; all smooth, blue). • determine whether a particular object belongs in a group (for example, place a buttercup blossom with other flowers, an oak leaf with other leaves). • select from a collection all the objects with the same attributes (for example, birds have feathers, mammals have hair). • group items as needed by humans or wanted by humans. • distinguish between natural objects and those that people have built.
Sequencing: Placing objects, events, or conditions in a sequence by observing and comparing a particular attribute.	Students will be able to • compare two objects, events, or conditions and choose one that exceeds the other in some dimension (for example, the tallest tree, the loudest noise, the event that takes longer to occur). • recognize the successive positions of the sun. • place pictures or living specimens of an acorn, oak seedling, young oak, and mature oak in proper sequence. • determine which event occurs earlier in the day—eating breakfast or eating lunch. • place several twigs on a surface in order from shortest to longest.

Process Skill	Illustrative Learner Outcomes
Understanding Spatial Relationships: Observing and comprehending the location of objects relative to each other by applying concepts such as direction, pattern, shape, length, width, location, or perspective.	Students will be able to • recognize the position of objects relative to each other (for example, scattered or in a line, far apart or close together, above or below, north of). • recognize two-dimensional shapes (for example, squares, triangles, circles) and three-dimensional forms (for example, cones, cubes, spheres). • recognize approximate two-dimensional shapes and three-dimensional forms in natural and human-made objects (for example, the full moon may appear circular, a conifer tree appears to be cone-shaped, a tree trunk resembles a cylinder, many windows are rectangular). • recognize that maps and globes are representations of the real world. • identify and use the cardinal directions (north, east, south, west) to locate places.

Processing, Refining, and Extending Perceptions

Process Skill	Illustrative Learner Outcomes
Measuring and Quantifying: Finding the size, quantity, extent, capacity, mass, or some other amount of something by determining how many arbitrary units or standard units it contains.	Students will be able to • determine the length of an object in terms of the length of a body part (for example, how many hand spans, paces, arm lengths). • measure distances between places in a neighborhood in terms of city blocks. • use a simple beam balance to determine the mass of an object in numbers of marbles. • determine the growth rate of a plant by using a meter stick to make periodic measurements of its height. • use a Celsius thermometer to determine the temperature of a liquid. • read a rain gauge in order to determine the quantity of rain that falls over a period of time.
Inferring: Using observations to draw tentative conclusions about that which is not directly or immediately observable.	Students will be able to • observe tracks and other animal traces in the snow to construct a story about an animal's behavior. • observe the condensation of water on cool objects to infer the presence of water in the air. • infer that plants wilt due to water loss by observing that adding water restores them to normal. • infer special functions of various parts of animals from observations of their forms. • use a list of observations of a spider building a web to infer the reason for the behavior or the function of the web.

Process Skill	Illustrative Learner Outcomes
Predicting: Formulating likely outcomes or estimating what is likely to follow based on repeated observations of a system.	Students will be able to • identify likely places on the school grounds where puddles will form when it rains. • suggest the result of mixing various primary colors. • suggest how a piece of common food might taste (for example, apple, orange, chocolate cookie, milk). • use observations of sun movements to predict that the sun will rise in the east each morning. • predict that it will feel cooler if a cloud moves between the sun and Earth. • forecast weather based on simple measurements of temperature, wind, and other factors.
Analyzing: Observing a system and its components in order to determine relationships among them.	Students will be able to • use observations and/or known information about the plants and animals in an area to construct a food chain/web diagram. • use observations and/or known information about the parts of a plant to explain how it functions as a living thing. • study the jobs of various members of a human community and how they are related and contribute to the functioning of the total community.
Interpreting: Determining the meaning of data and other information collected through observation of a system.	Students will be able to • measure and record data for the growth of a plant over time, measure and record the amount of water a plant uses over time, display the data in the form of a bar graph, and use the graph to explain how the plant grew over time. • hold the end of rods of different materials in a flame, note which ones heat the fastest, and conclude that materials differ in their ability to conduct heat. • observe a closed glass bottle of water that has frozen and broken and conclude that water expands when it freezes. • plant bean seeds in six containers of soil, providing three with water but not the other three. Conclude that bean seeds need water in order to germinate.

Aesthetic Awareness and Sensitivity

As students receive and process stimuli, they respond emotionally and begin to develop an aesthetic awareness and sensitivity. It is important for teachers to recognize and nurture such responses and to provide numerous opportunities for students to maximize the use of their senses in a wide variety of environments, natural and human-made. Sensory-oriented experiences like those contributing to the development of perceptual awareness begin with the receipt of a stimulus. This is followed by an emotional response and that in turn by contemplation about the source of the stimulus. Attitudes and values are influenced as the senses act together with cognitive processes to produce decisions upon which people act. For example, a natural scene such as a sunset over a lake may not be perceived only as a blending of artistic elements such as shape, color, line, or texture, but also as a harmonious interaction of living and nonliving environmental elements that form a terrestrial ecosystem. The real value of the experience of observing the sunset is that in evoking pleasure, it helps to develop a conviction that the scene is unique or perhaps even something eternal, and thus leads to positive environmental behavior, a desire to protect and sustain the ecosystem.

Aesthetic sensitivity and awareness provide a basis for the development of an environmental ethic. If the senses are allowed to atrophy, people tend to either accept or fail to recognize environmental destruction. Involving students in sensory experiences provides input into attitudinal changes that bring about behavior leading to environmental renewal and preservation.

Sensory-oriented experiences designed to develop perceptual awareness also have an intrinsic value. They help students learn to cherish the beauty around them and motivate creative expression in various art forms—visual, musical, dance, story telling, and creative writing. Such experiences also provide temporary relief from the unsettling effects of modern-day society, carrying an implicit promise of satisfaction of one's idealistic aims. The earlier children experience this relief, the better they will be able to deal with these societal effects later in life.

. . . For though the eye is the human master sense and chief aesthetic gate, the creation of a mood or of a moment of earth poetry is a rite for which the other senses may be properly invoked . . . . We ought to keep all our senses vibrant and alive. Had we done so, we should not have built a civilization which outrages them, which so outrages them, indeed, that a vicious circle has been established and the dull sense grown duller.
—Henry Beston

The Relationship of Perceptual Awareness to the Other Subgoals

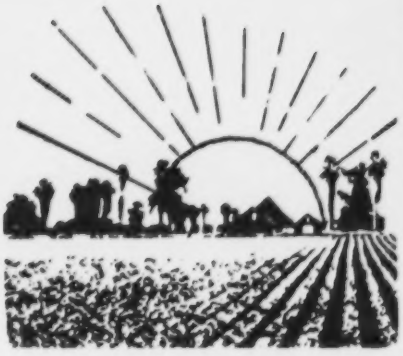
The process skills included in Figure 2 not only contribute to the development of perceptual awareness but are prerequisite to constructing knowledge about the environment. Without the elements awareness activities, students are often not ready to construct meaningful knowledge. The importance of these skills in developing a positive environmental ethic has already been pointed out. They are also basic to the development of citizen action skills. These relationships will be discussed in greater depth in section 6.

Subgoal: Knowledge

To help students acquire a basic understanding of how the natural environment functions, how its functioning is affected by human activity, and how harmony between human activity and the natural environment may be achieved.

A knowledge base about how the natural environment functions is essential, for without such knowledge citizens cannot make wise decisions about how to interact with the environment and how to prevent and resolve issues resulting from those interactions.

In identifying what knowledge is important, the prevailing practice has been to choose a topical rather than a conceptual approach, to base curriculum on discrete facts rather than significant ideas that connect and provide structure to content. This latter kind of knowledge is described in level 1.30—Knowledge of the universals and abstractions in a field—in Figure 3.



The grand show is eternal. It is always sunrise somewhere; the dew is never all dried at once; a shower is forever falling; water vapor is ever rising. Eternal sunrise, eternal sunset, eternal dawn and gloaming, on sea and continents and islands, each in its turn, as the round earth rolls.
—John Muir

■ Figure 3

Taxonomy of Educational Objectives: Cognitive Domain: Knowledge

Reprinted with permission from *Taxonomy of Educational Objectives: The Classification of Educational Goals: Handbook I: Cognitive Domain*, by Benjamin S. Bloom, ed. New York: David McKay Co., Inc., 1956.

1.00 Knowledge
- 1.10 Knowledge of specifics
  - 1.11 Knowledge of terminology
  - 1.12 Knowledge of specific facts
- 1.20 Knowledge of ways and means of dealing with specifics
  - 1.21 Knowledge of conventions
  - 1.22 Knowledge of trends and sequences
  - 1.23 Knowledge of classifications and categories
  - 1.24 Knowledge of criteria
  - 1.25 Knowledge of methodology
- 1.30 Knowledge of the universals and abstractions in a field
  - 1.31 Knowledge of principles and generalizations
  - 1.32 Knowledge of theories and structures

Knowledge important to environmental education can be organized into the following three categories of fundamental principles.

Earth's Natural Environment

This category includes knowledge about relationships between Earth's energy budget and its life-support system and knowledge about the life-support system itself. The primary source of the principles in this category is natural science curricula.

Humans as Ecosystem Components

This category includes knowledge about how humans use ecosystems to satisfy their needs and desires, the ecological dominance of humans, the effects of ecosystems on humans, and the continuous nature of ecosystem-human interactions. Some principles included in this category are drawn from natural science curricula and others from social studies curricula.

If humans were to disappear from Earth, the other plants and animals would largely be unaffected; if the other plants and animals were to disappear, however, human beings would disappear as well.
—Bruce Wallace

Harmony Between Human Activity and the Natural Environment

This category includes knowledge about the barriers to and methods of achieving harmony and the basic procedures used to pursue harmony. The principles included in this category are drawn from social studies curricula.

These three categories of fundamental principles are presented in outline form in Figures 4, 5, and 6, generally in terms of level 1.30—Knowledge of the universals and abstractions in a field—but all levels of knowledge are represented. In addition, associated conceptual elements of each principle are provided.

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Figure 4

Earth's Natural Environment

Principles and Subprinciples	*Associated Concepts*
A. Earth's environment operates as a system supported by conditions that are functions of Earth's structure and place in the solar system.	
1. Solar energy is the primary source of energy for all biogeochemical cycles and other processes occurring on Earth.	solar energy, biogeochemical cycles
2. Nuclear processes, geothermal sources, tidal movements, and gravity are secondary sources.	nuclear reactions, geothermal energy, tides, gravity
3. Earth is in a state of overall energy balance absorbing energy from the sun and radiating it into space.	earth's energy budget, absorption, radiation
4. Earth's daily rotation, annual revolution around the sun, and differential absorption of solar energy result in the movement of air masses, ocean currents, and the hydrologic cycle, giving rise to Earth's prevailing weather and climates, and providing conditions essential to life on Earth.	air mass, hydrologic cycle, evaporation, condensation, precipitation, transpiration, ocean currents, differential absorption, convection, radiation, conduction, weather, climate
B. Earth's environment is a complex, interrelated, interactive, dynamic, constantly changing macrosystem called the biosphere.	macrosystem
1. The biosphere is composed of a mosaic of interacting systems called ecosystems.	biosphere, system, interaction
a. An ecosystem is a recognizable, homogeneous unit existing at a particular point in space and time, consisting of three groups of components: (1) physical (sun's energy, climate, rocks, water); (2) life forms (including humans); and (3) interactions between living and nonliving components (competition, erosion, decomposition).	ecosystem, abiotic, biotic, life form, competition, decomposition, erosion, biome
b. The characteristics of an ecosystem, derived from the interaction of its components, differ from the characteristics of individual components and can be understood only when studied as a complete functioning unit.	interaction, components, unit
c. Characteristics of a species of organism depend upon interactions of its genetic composition with the environment.	interaction, organism, genetic composition, species
d. Ecosystem processes are limited by physicochemical attributes (energy, materials, space, time) and the inherited characteristics of organisms.	energy, space, matter, time, genetics

Principles and Subprinciples	*Associated Concepts*
e. These characteristics adapt a population of an organism to function in a particular role known as a niche. Populations of organisms are interdependent with one another and with their physical environment.	adaptation, population, niche, interdependence, organism, habitat
f. Both ecosystems and species of organisms vary in their ecological amplitude, that is, their limits and capacities to interact with other components of the ecosystem, and with other ecosystems.	ecological amplitude, biological magnification
2. The biosphere has been and is undergoing dynamic, continuous change.	change, dynamic
a. Environmental factors, such as climate, topography, geologic processes, and the distribution of oceans and continents, have changed throughout Earth's history.	climate, topography, geologic processes, continental drift
b. Organisms have changed greatly through many small, consecutive modifications of their genetic composition, thus adapting to a changing environment. Organisms that have failed to adapt have become extinct.	genes, DNA, mutations, adaptation, extinction, evolution
c. New ecosystems are created as organisms invade formerly lifeless water or bare mineral substrates (such as rock) or as existing ecosystems are modified.	ecosystem evolution, substrate, succession
(1) New combinations of organisms and environments result in new ecosystems.	ecosystem evolution
(2) Interactions of living and nonliving components change the character of an ecosystem.	biotic, abiotic, evolution
(3) Natural and human processes, such as fires, landslides, earthquakes, volcanism, and urbanization, alter ecosystems in varying degrees.	landslide, earthquake, urbanization, succession, volcanism
(4) Ecosystems have various degrees of resiliency to alteration, giving them varying capacities and rates of recovery from alteration.	ecosystem, stability, resiliency
(5) Ecosystems can be reduced to near or actual extinction by the removal or addition of components and the change of processes, but unless the area is rendered toxic to all life for extended periods, a new ecosystem subsequently will develop.	ecosystem evolution, extinction, toxicity
d. As ecosystems persist and mature over time, there is a tendency toward an increase in the diversity of organisms.	biological diversity, ecosystem maturation

Principles and Subprinciples	*Associated Concepts*
(1) Mature ecosystems are cybernetic; they have a steady-state character even though individual organisms and species arrive, die, or depart, and even though particular kinds of organisms may not always be present.	stability, steady-state
(2) Mature ecosystems tend to be very stable, with more resilience to physical, biological, economic, and social variations than developing systems.	stability, resiliency
e. Niches become more specialized as ecosystems mature.	niche specialization, ecosystem maturation
(1) Niche specialization occurs when ecosystem changes interact with organism changes.	ecosystem change, organism change
(2) Niches can be expanded if species learn new behaviors, thus enabling more types of organisms to live in an ecosystem and further modify its character.	niche expansion, succession, ecosystem evolution, behavior
f. Some ecosystem characteristics are influenced strongly by the origin and history of the ecosystem.	ecosystem evolution
3. Energy and materials required for life pass into or are found in the biosphere and are components of each ecosystem.	biosphere
a. Most ecosystem energy comes originally and primarily from the sun; materials come from components of the biosphere.	solar energy, matter, biosphere
b. Through photosynthesis, green plants and other organisms containing chlorophyll use solar energy to convert water, carbon dioxide, and small amounts of minerals into high energy organic compounds that power all life processes.	photosynthesis, water, carbon dioxide, mineral, organic, compound, life process
(1) The process of respiration releases this energy in other organisms.	respiration
(2) The processes of photosynthesis and respiration are limited to a narrow range of temperatures, moisture, and chemical conditions, and by the genetic composition of organisms.	photosynthesis, respiration, genetic composition
c. Materials are cycled and recycled through ecosystems via pathways known as food webs. In food webs materials pass through plants, through herbivores, and through carnivores. At any of these three levels, decomposers may reduce organic matter to inorganic, thus completing the cycle.	cycle, recycle, food chain, food web, herbivore, carnivore, producer, consumer, parasite, soil, micro-organism, decay, organic, inorganic, omnivore, predator, prey, scavenger, decomposition, law of conservation of matter, gross primary production, decomposers

Principles and Subprinciples	*Associated Concepts*
d. Some energy moves through geophysical and geochemical components of ecosystems; the rest through food webs.	energy conversion, efficiency, energy, dissipation, energy transfer, geophysical, geochemical, entropy
(1) Energy conversions in food webs are never 100 percent efficient, so energy is constantly dissipated from the system, resulting in a deficit.	energy conversion, efficiency, energy pyramid
(2) A constant infusion of energy from the sun is required for organisms and ecosystems to live and grow.	energy infusion, solar energy
(3) Some energy is stored in organic materials and is available for future use.	energy storage, organic matter, fossil fuels
e. Most natural ecosystems are adapted to operate on the energy and materials directly available to them. These resources are renewable through recycling.	cycles, material consumption, material renewal, rate of consumption, rate of renewal, biomass
(1) In natural ecosystems the rates of consumption and renewal are balanced.	consumption, renewal, renewable resource
(2) In ecosystems containing primitive human social groups, these rates are also balanced.	ecosystem balance, renewable resources, biomass, social group
(3) In ecosystems containing modern human social groups, there is a demand for heavy subsidization of energy and materials.	social group, renewable resource, nonrenewable resource
4. Each ecosystem of the biosphere contains a number of species populations, the size and stability of which vary, depending on biotic and abiotic changes in the system.	species, population stability, biotic, abiotic, community
a. A population introduced into an ecosystem to which it is adapted shows a typically s-shaped pattern of growth as births exceed deaths, a leveling off as the rates equalize, and a decline as the death rate exceeds the birth rate.	population, s-shaped growth curve, birth rate, death rate, population dynamics, homeostasis, exponential growth
b. Population, birth, and death rates are influenced by intrinsic and extrinsic limiting factors.	intrinsic, extrinsic, limiting factor, fertility rate, immigration, emigration
(1) Intrinsic factors are genetic and include reproductive capacity, innate behavior, food requirements, and resiliency.	intrinsic factor, genetic, reproductive capacity, innate behavior, food requirements, resiliency, carrying capacity
(2) Extrinsic factors are environmental and include chemical factors, such as nutrients and toxins, physical factors, such as temperature	extrinsic factor, nutrient, toxin, temperature, humidity, competition, predation, parasitism,

Principles and Subprinciples	*Associated Concepts*
and humidity, and factors related to interactions with its own and other populations, such as competition, predation, parasitism. Population density affects all extrinsic relationships.	population density, carrying capacity, interaction, symbiosis
(3) The modern human birth rate is affected primarily by socio-cultural means, for example, delay in marriage, family planning; the death rate by technology, for example, medical science, sanitation, dietary improvement. The net result of recent changes in both rates has been a substantial increase in the size and growth rate of Earth's human population.	socio-cultural, marriage, family planning, medical science, sanitation, diet, human population growth, birth rate, death rate
c. Population size in an ecosystem will vary over time with changes in physicochemical factors and with biological interactions, thus defining a carrying capacity of the ecosystem for a population under a given set of conditions. Within finite limits, technology can increase an ecosystem's carrying capacity.	physicochemical factor, biological interaction, carrying capacity, finite, technology, population dynamics
d. Spatial arrangements and total numbers of individuals in a population are equally important in ecosystem functioning.	space, spatial arrangement, population
e. Population distribution is controlled by ecological amplitude, environmental barriers to dispersal, and history.	ecological amplitude, dispersal, population distribution

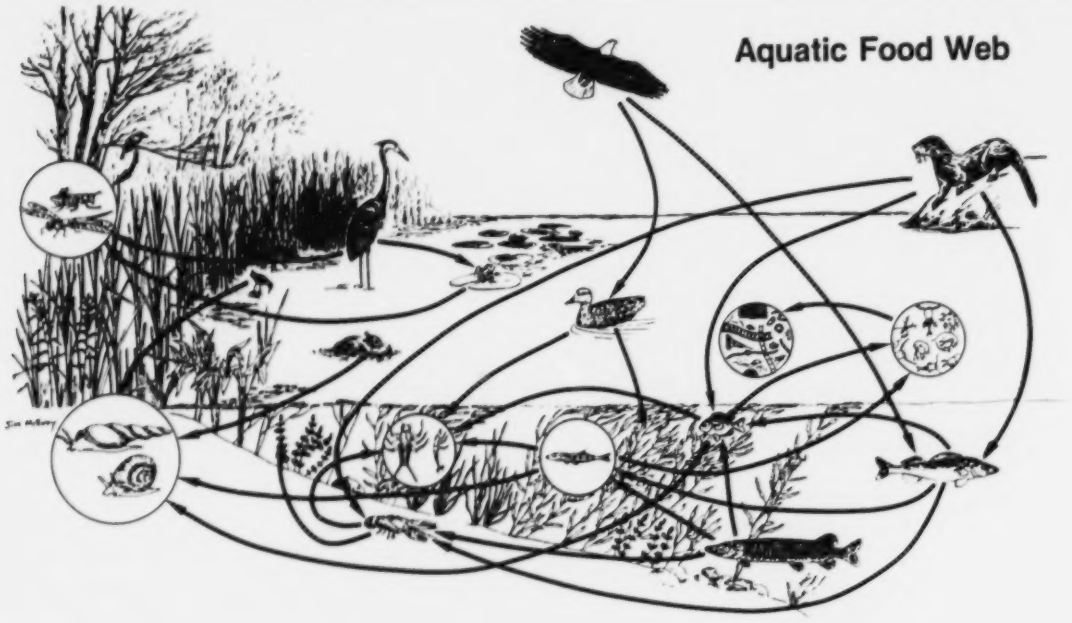


Figure 5

Humans as Ecosystem Components

Principles and Subprinciples	*Associated Concepts*
A. Humans use ecosystems to satisfy basic needs and desires.	
1. Basic biological needs that must be met for humans to live and grow include habitable climate, energy, food, water, other materials, rest and exercise, other humans for reproduction, and protection against environmental stresses.	basic biological needs, climate, energy, materials, rest, exercise, reproduction, environmental stress, food, water
2. Humans cannot grow and completely develop mentally unless essential psychological and social needs and desires are met. These include security, love, esteem, self-fulfillment, social interaction, health, comfort, material goods, and spiritual experiences.	psychological needs, social needs, desires, security, love, esteem, self-fulfillment, social interaction, health, comfort, material goods
3. Each human culture has its own perceived needs and desires that make different demands and impacts on ecosystems. In times of stress many of these needs and desires can be adjusted.	culture, perceived needs, perceived desires, environmental impact
a. Culturally specific perceived needs include • preservation of land and ecosystems and the conservation of materials and energy; • satisfaction of desires for status and for exotic materials and experiences; • economies of scale concentrating human activities; • planned obsolescence of manufactured goods; and • dietary customs, family size, and work attitudes.	culturally perceived needs
b. Universal human desire for increasing amounts of material goods is expressed differently in different cultures. The human impact on ecosystems increases as these desires are satisfied.	cultural expression, material good, environmental impact
c. Value systems are an important factor in determining the kind and extent of a society's impact on ecosystems.	values, value system, society
d. Increasing the consumption of energy and materials often leads to deleterious impacts on ecosystems such as	environmental impacts

Principles and Subprinciples	*Associated Concepts*
• increased carbon dioxide and heat in the atmosphere, resulting in global warming; • changes in the reflective power of Earth; • introduction of synthetic substances that may be toxic, mutagenic, or carcinogenic; and • heat islands over urban areas.	
e. Concentration of humans in built environments intensifies the deleterious effects of humans on ecosystems.	impact of urbanization
B. Humans are an all-pervasive species in the ecosphere and thus exert a special ecological dominance.	human ecological dominance
1. Human ecological domination results from various factors.	
a. Intellectual capacities permit development of • technology, giving unique control over energy flow, food and goods production, disease, and other factors that could limit human populations;	human intellectual capacity, technology
• unique institutional and technological control over other populations in ecosystems such as the domestication of species, suppression of undesirable species, and the encouragement of desirable species.	species population control
b. Human biological and cultural adaptation to a wide range of environmental conditions may result in either positive or negative effects.	human adaptation to environments, environmental impact
c. Sheer human population size results in ecological domination.	dominance by population size
d. Specialization and diversity in the division of labor allows for ecological domination.	division of labor
2. Human tendencies to form and function in social and corporate groups and institutions promote development of human habitats that create unique concentrated demands on ecosystems and further increase human impacts on ecosystems.	social group, social institution, urbanization, corporate group
a. These effects are intensified by the concentration of humans in small areas.	impact due to population concentration

Principles and Subprinciples	*Associated Concepts*
b. The effects of human settlements of a metropolitan scale on ecosystems rival those of mountains, glaciers, droughts, and floods.	impact of large urban areas
3. Recent rapid increases in human populations and technological capabilities have accelerated ecosystem changes until some are potentially irreversible.	accelerated ecosystem change, impacts of rapid human population growth, impacts of rapid technological growth, irreversibility
4. Human aesthetic, ethical, moral, and spiritual values may reinforce or conflict with harmonious relationships within ecosystems.	impacts of human value systems
C. Ecosystems affect humans.	
1. Humans and all their products function in an ecosystem framework.	
a. Built environments radically transform human societies and cultures.	built environments, human societies and culture
b. Past ecosystem processes and events have produced major biological and cultural differences in human populations.	past ecosystem impacts on human populations
2. Biosphere changes due to increasing human population and technology have both short- and long-term effects.	short term, long term
a. Short-term effects include changes in • birth and death rates; • biological fitness of human populations as measured by growth rates, disease patterns, nutritional levels, and aging; • use of nonrenewable materials and stored energy resources; and • functional capacities of individuals and populations, for example, mental productivity and attitude.	short term, long term, birth rate, death rate, population growth rate, disease, nutrition, aging, nonrenewable resource, functional capacity
b. Long-term effects include changes in • genes and chromosomes and their evolutionary consequences; • elimination or introduction of selection pressures; • ecosystems due to evolution of component populations;	long term, genes, chromosomes, evolution, population, life cycle, renewable resources, nonrenewable resources, culture

Principles and Subprinciples	*Associated Concepts*
• health and life cycles; • global climate; • reserves of nonrenewable and renewable resources; and • culture.	
3. The built environment and its psychological milieu have a powerful effect on humans. Information transfer by verbal communication and learned behavior operates on humans in a parallel and synergistic manner in much the same way as do physical and chemical components of ecosystems.	built environment, psychological milieu, synergistic
D. Complex interactions among humans and other ecosystem components occur continuously.	
1. Humans' perceptions of their needs, their impacts on ecosystems, and ecosystem impacts on them reflect the cultural and individual values, goals, skills, insights, and capabilities of the individuals, groups, institutions, and nations involved.	needs perception, values, goals, skills, insights, capabilities
2. Relationships among components of ecosystems are reciprocal, ranging from mutually beneficial to unidirectionally destructive.	ecosystem components, reciprocal, mutually beneficial, unidirectional
3. Feedback mechanisms of different kinds, for example, physical, chemical, social, and behavioral, ranging from rudimentary to highly sophisticated, govern relationships among and within components of ecosystems.	feedback mechanisms
4. Human activities often have synergistic effects on ecosystems and vice versa.	synergistic effects
5. Human activities affect ecosystem maintenance and management.	
a. Potentially positive activities of humans within ecosystems include • domesticizing plants and animals; • reducing disease and mortality; • constructing and controlling space for living, working, manufacture, storage, recreation, and transportation; • preserving genetic stocks of nondomesticated organisms and preservation of specific ecosystems; • appreciating ecosystems and their components;	positive human activities

Principles and Subprinciples	*Associated Concepts*
• developing human laws and property rights; • reducing human populations under certain social-cultural conditions; and • elaborating functional roles for humans, which increases diversity of ecosystems.	
b. Potentially destructive activities of humans within ecosystems include • bringing on large-scale events (such as oil slicks, floods, atmospheric changes) that warn of imbalances between human activities and ecosystem functions; • reducing the number of individuals in a species; interrupting the continuity or reducing the area of ecosystem types and reducing the average species diversity for a given ecosystem type; • increasing environmentally related human health problems, such as pollution-induced disease, noise-induced deafness; • deliberately or inadvertently destroying or modifying habitats; • creating and concentrating pollutants; • dissipating energy and producing pollutants at high rates in urban areas; • depleting relatively concentrated sources of raw materials.	destructive human activities

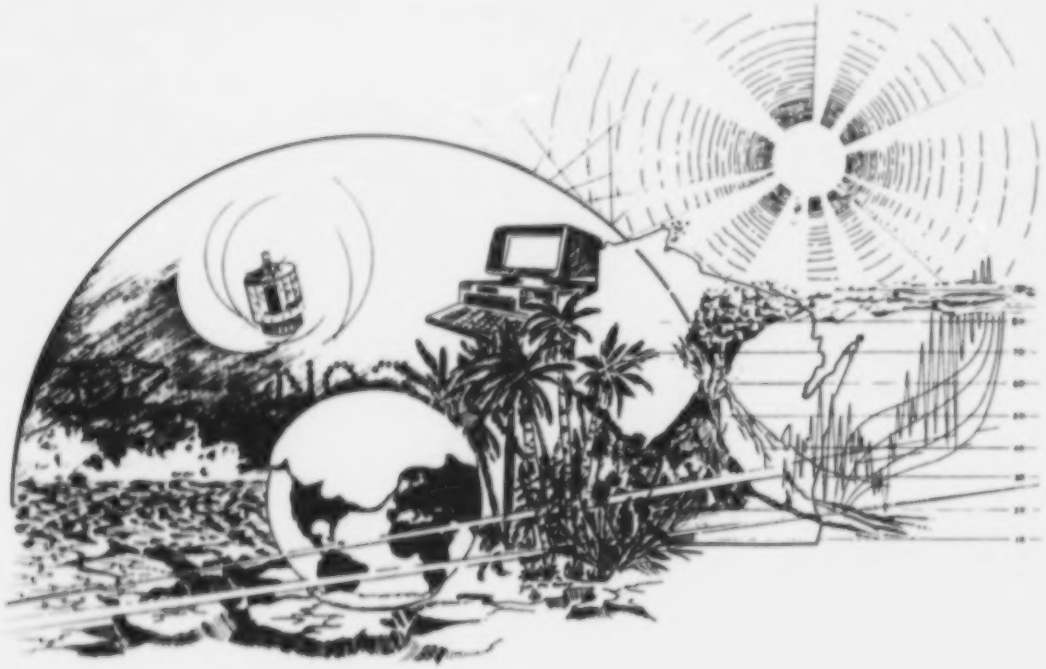


Figure 6

Achieving Harmony Between Human Activity and the Natural Environment

Principles and Subprinciples	*Associated Concepts*
A. Methods by which human activities may be harmonized with ecosystem processes are complex, and outcomes of attempting to do so are not always predictable.	
1. Barriers to harmony include the	
• inevitable, continuing, and largely unmanageable effects of ecosystem changes on human biology and culture;	ecosystem impacts on humans
• lack of foresight capability, the incompleteness or unavailability of detailed knowledge needed to make environmental predictions; and	foresight capability
• lack of uniformly dependable social-political processes for responsible decision making.	decision-making process
2. Harmony can be pursued through the	
• formal and informal education of the public;	formal education, informal education, art form, policy, standard, economic incentive, social incentive, guideline, business, industry, government agency, citizen organization, environmental protection agency, natural resource agency, statute
• practice of various art forms to develop human sensitivity to and appreciation of environmental quality;	
• encouragement of corrective actions by individuals, business and industry, citizen organizations, and government agencies;	
• use of economic and social incentives;	
• voluntary adoption and implementation of policies, guidelines, and standards;	
• establishment of formal policies, guidelines, and standards; and	
• enforcement of policies, guidelines, and standards.	
3. Institutions for promoting harmony include	institution, family, education, media, religion, science, technology, industry, commerce
• family;	
• education;	
• media;	
• religion;	
• science/technology;	
• civic/social;	
• government; and	
• industry/commerce.	

Principles and Subprinciples	*Associated Concepts*
B. A basic procedure for harmonizing human activities with ecosystem processes can be described as a series of steps.	
1. Develop an in-depth understanding of ecosystem components, the processes in which they are involved, how human activities affect the ecosystem, both positively and negatively, and how the ecosystem affects its human members.	ecosystem component, interactions, ecosystem process
2. Recognize the importance of the ecosystem components and processes and the significance of any ecosystem changes that have occurred or are occurring.	ecosystem component, ecosystem process, interaction, ecosystem change
3. Identify the cause(s) of the ecosystem change.	ecosystem component, ecosystem process, interaction, ecosystem change
4. Develop alternative action strategies that maintain and enhance beneficial changes and reduce detrimental changes, paying particular attention to possibly irreversible changes and identifying desirable short- and long-range outcomes.	action strategy, beneficial change, detrimental change, irreversible change, short range, long range
5. Analyze and evaluate alternative action strategies using a broad array of environmental, social, and economic criteria, recognizing that criteria may differ according to circumstances of politics, geography, scale, time, and society.	action strategy, environmental criteria, social criteria, economic criteria
6. Select among the alternative action strategies, and adopt a policy that can be implemented at all levels, individual through universal.	alternative action strategy, policy
7. Determine and initiate the actions needed to implement the policy.	
8. Monitor and evaluate the effects of the policy.	
9. Feed the information gained in Step 8 into Step 1 to adjust the procedure as needed.	feedback

The Relationship of Knowledge to the Other Subgoals

The success of the basic procedure outlined in part B of Figure 6 depends on how well the fundamental principles included in Figures 4 and 5 are understood and applied. The process skills of the perceptual awareness subgoal are used to construct this knowledge, and as it accumulates the student develops a different kind of awareness, a conceptual awareness. A conceptual awareness enables the student to recognize that something within an ecosystem is not the way it should be and that the basic procedure of part B, Figure 6 needs to be implemented. Thus this basic procedure is closely related to the subgoals of citizen action skills and citizen action experience.

Subgoal: Environmental Ethic

Right thinking precedes right action. This seems like a truism. But it applies to ecological ethics in a particularly immediate sense. For good or ill, ethics forms an integral part of the natural pattern . . . .
—David Oates

To help students develop a universal ethic on which they may act to defend, improve, and sustain the quality of the environment.

Environmental issues are not only factual questions such as those dealt with by natural and social scientists, but ethical questions—questions about proper goals and actions for society and the individuals composing it. An environmental ethic that helps to preserve the ecological integrity of not just Earth, but of the entire universe, must be part of each person's total being.

The Nature of an Ethic

An ethic is a sense of what is fundamentally right or wrong, a self-imposed moral code that helps an individual determine relative values, make choices regarding them, and accept personal responsibility for those choices. An ethic develops as a person experiences and learns from making moral decisions. At any point in a person's life, he or she subscribes to a particular set of beliefs, attitudes, and values. As the person experiences situations in which moral decisions must be made, those beliefs, attitudes, and values may change (see page 70). As the person matures into adulthood, these beliefs, attitudes, and values become a self-imposed moral code, a sense of what is fundamentally right or wrong.

Thus, it is necessary to understand the nature of beliefs, attitudes, and values in order to understand the nature of ethics. Figure 7 defines, provides examples, and shows the relationships between these three terms.

Figure 7

Beliefs, Attitudes, Values, and Ethics

Term	*Meaning*	*Example*
Belief	A simple proposition, conscious or unconscious, inferred from what a person says or does, which can be preceded by the phrase, "I believe that . . ."	"I believe that world population growth is the basis for many environmental problems in Third World nations."
Attitude	An aggregation of related beliefs, a part of a belief system.	"I dislike large cities because all the motor vehicles make so much noise.
Value	Something an individual considers to be very important and worthy of being cherished.	"I value a quiet environment."

Beliefs, attitudes, and values are always directed toward tangible objects and events or intangible ideas and thoughts and can be classified. Most people agree that there is a set of universally accepted values, some that deal with behavior and some that deal with desirable conditions resulting from those behaviors. Some universally accepted values may include cleanliness, cross-cultural empathy/concern, ecologically positive behavior, forgiveness, honesty, kindness, love of others, love of self, politeness, responsibility, tolerance, a balanced global ecosystem, education, equality, freedom for all people, inner harmony, love and respect for Earth, moral courage, self-reliance, sustainable development, wisdom, a world at peace, and a world of beauty. (Caduto, 1985)

Values also may be categorized as they are in the following list. (Hungerford, 1992)

Aesthetic: an appreciation of beauty in the environment through the use of the senses.

Cultural: a concern for the continuation/preservation of tribal or societal knowledge, beliefs, values, art, customs, and so forth.

Ecological: a concern for the maintenance of the integrity of natural systems, including homeostasis and diversity.

Economic: a concern for the accumulation, use, and exchange of money and materials.

Educational: a concern for the accumulation, use, and communication of knowledge.

Egocentric: a desire to focus on individual self-satisfaction and fulfillment; a "me" orientation.

Ethical/Moral: a concern for present and future responsibilities, rights, wrongs, and "should and should nots" concerning human-to-human interactions and human-to-environment interactions.

Health: a concern for the maintenance of environmental conditions contributing to a positive human physiological state.

Political: a concern for activities, functions, and policies of governments and their agents.

Recreational: a concern for the maintenance of conditions contributing to opportunities for leisure activities.

Religious: a concern for belief systems based on faith and dogma.

Scientific: a concern for those attributes associated with empiricism and empirical research.

Social: a concern for shared human empathy, feelings, status, and other human interactions.

Environmental attitudes and values also might be directed toward and grouped by the following headings:

- the natural environment;
- human relationships with nature;
- the built environment, which results from human design and development;
- one's self-image; and
- other people, including future generations.

Ethics is the wisdom that places human action in its full context. Since individuals seldom see this full perspective, ethics grows communally, and takes on communal enforcement. The challenge, now, is to recognize the standing of the nonhuman world as part of our community, whose fate is entwined with ours.
—David Oates

Developing an Environmental Ethic

Research shows that moral development occurs in stages (see section 4). Michael Caduto points out that students in grades K-6, or up to an age of 11 or 12 years, have not yet developed higher powers of cognitive and moral reasoning or a personal environmental ethic. They require assistance in making most moral decisions. It is important that students

- acquire a set of positive social and environmental values as part of a general moral education provided by the family and other institutions (see page 70);
- develop a personal environmental ethic based on the realization that people are part of ecosystems, that what is good for ecosystems is also good for people, that the quality of the environment and the quality of life are directly related, and that all people have a right to share in the benefits ecosystems provide;
- develop the ability to function as a morally literate person capable of making conscious, caring, responsible moral decisions; and
- satisfy their essential human needs in order that they eventually become a self-actualized, integrated person capable of being and willing to be concerned with social and environmental moral issues.

As students move into their teens and into higher grade levels, many begin to use higher levels of cognitive and moral reasoning and develop a personal environmental ethic. They develop the ability to make moral decisions on their own. It is important that these students

- achieve greater awareness and understanding of their and other peoples' social and environmental values and how these affect behavior;
- learn to compare their personal values with those most beneficial to social and environmental welfare, thus encouraging further development of a personal environmental ethic; and
- satisfy their essential human needs so they may continue to become a self-actualized, integrated, morally literate person concerned with and actively promoting both social and environmental welfare.

Illustrative Learner Outcomes for an Environmental Ethic

As stated earlier in this section, the perceptual awareness subgoal is in part related to the two lowest levels—receiving and responding—of the Taxonomy of Educational Objectives: Affective Domain. The environmental ethic subgoal also includes those two levels plus the remaining three: valuing, organization, and characterization by a value or value complex (Figure 8).

. . . Understanding the global dimensions of the environmental crisis is merely a realistic observation about the scale of the planet's mismanagement. What is also needed, as many others have noted, is a deeper, more spiritual approach to nature from which we can derive an environmental ethic.
—Peter Borrelli

Figure 8

Taxonomy of Educational Objectives: Affective Domain

Reprinted with permission from *Taxonomy of Educational Objectives: The Classification of Educational Goals: Handbook II: Affective Domain* by David R. Krathwohl, Benjamin S. Bloom, and Bertram B. Masia. New York: David McKay Co., Inc., 1964.

Subgoals: Perceptual awareness and environmental ethic

1.0 Receiving (attending)
- 1.1 Awareness
- 1.2 Willingness to receive
- 1.3 Controlled or selective attention

2.0 Responding
- 2.1 Acquiescence in responding
- 2.2 Willingness to respond
- 2.3 Satisfaction in response

Subgoal: Environmental ethic

3.0 Valuing
- 3.1 Acceptance of a value
- 3.2 Preference of a value
- 3.3 Commitment

4.0 Organization
- 4.1 Conceptualization of a value
- 4.2 Organization of a value system

5.0 Characterization by a value or value complex
- 5.1 Generalized set
- 5.2 Characterization (developing a consistent philosophy of life)

The ecological worldview begins with factual science, but ends with conclusions about values.
—David Oates

It is suggested that curriculum planners review the work of Krathwohl and his associates before attempting to develop curricula under this subgoal. The task of curriculum planners is to relate the components of the program to this taxonomy in order to establish objectives appropriate to the program they are developing. Illustrative learner outcomes for each sublevel are provided in Figure 9.

As Krathwohl, Bloom, and Masia point out in reference to level 5.0: Characterization by a value or value complex:

> Rarely, if ever, are the sights of educational objectives set to this level of the affective taxonomy. Realistically, formal education cannot reach this level, at least in our society. In all open and pluralistic societies, such as our own, the maturity and personal integration required at this level are not attained until at least some years after the individual has completed formal education. Time and experience must interact with affective and cognitive learnings before the individual can answer the crucial questions, "Whom am I" and "What do I stand for?"

In the more traditional society, a philosophy of life and a mode of conduct are spelled out for members at an early stage in their lives. A major function of education in such a society is to achieve the internalization of this philosophy.

Figure 9

Taxonomy of Educational Objectives: Affective Domain

Illustrative Learner Outcomes for an Environmental Ethic

1.0 Receiving

1.1 Awareness

The student will

- recognize differences in color, form, shape, arrangement, and design in objects and structures.
- observe and recognize with increasing differentiation sights and sounds encountered in and out of the classroom and school building.
- recognize the interdependence of all living things.

1.2 Willingness to receive

The student will

- develop a sensitivity to human needs and pressing environmental and social problems.
- exhibit a willingness to use his or her senses to explore an environment

1.3 Controlled or selected attention

The student will

- become sensitive to the importance of keeping informed on environmental issues.
- look for relationships among the various organisms found in an environment he or she is exploring.

2.0 Responding

2.1 Acquiescence in responding

The student will

- exhibit a willingness to comply with environmental regulations.
- observe nature center rules such as staying on trails, littering, collecting specimens.
- exhibit a willingness to work with others on the resolution of environmental issues.

2.2 Willingness to respond

The student will

- voluntarily seek information about the physical environment.
- practice the conservation of natural resources.
- develop a sense of responsibility for participating in the resolution of environmental issues.

2.3 Satisfaction in response

The student will

- display a strong interest in a variety of elements of the natural environment.
- find pleasure in reading books or watching television programs about the environment.
- find enjoyment in participating with other students in outdoor activities.

3.0 Valuing

3.1 Acceptance of a value

The student will

- grow in a sense of kinship with all of Earth's living creatures.
- feel himself/herself to be a member of groups involved in the resolution of local, state, national, and/or international environmental issues.
- demonstrate a responsibility for participation in public discussions of environmental issues.

3.2 Preference for a value

The student will

- try to persuade elected and appointed government officials to take action on environmental issues.
- express a preference for certain aesthetic elements of the environment.

3.3 Commitment

The student will

- demonstrate loyalty to the environmental and social goals of society at all levels, local through universal.
- exhibit faith in the power of reason and in experimentation and discussion as methods of resolving environmental issues.

4.0 Organization

4.1 Conceptualization of a value

The student will

- discover and define basic assumptions underlying a code of environmental ethics.
- form judgments as to the responsibility of society for conserving natural resources for future generations.

4.2 Organization of a value system

The student will

- weigh alternative environmental policies and practices against the welfare of people and other living things rather than the advantage of specialized, narrow interest groups.
- attempt to determine how the concept of a democratic society can be related to the conservation of natural resources for future generations.
- begin to form judgments as to the major directions in which global society should move in respect to environmental policies and practices.

5.0 Characterization by a value or value complex

5.1 Generalized set

The student will

- exhibit a readiness to revise judgments and to change behavior in respect to the environment in light of evidence of a negative impact of previous behavior on the environment.
- increasingly rely on methods of science in finding answers to questions about environment and society.
- judge environmental issues and problems in terms of ecological, economic, social, and political consequences rather than in terms of fixed, dogmatic precepts or emotionally wishful thinking.

5.2 Characterization

The student will

- develop a code of environmental behavior based on ethical principles consistent with maintaining the ecological integrity of Earth.
- develop a philosophy of life consistent with the role of humans as equal but not dominant members of the community composed of Earth and all its living things.

To help students develop the skills needed to identify, investigate, and take action toward the prevention and resolution of environmental issues.

Citizen action is a long-standing tradition in the United States. It was through citizen action in the 1770s that the democratic republic called the United States of America came into being. Those citizens who struggled more than 200 years ago did so to ensure their right, and the right of future citizens, to participate in the republic's governance. Citizens are not just residents of a municipality, nor are they just people who enjoy rights guaranteed by law, such as the right to vote. Rather, citizens are people who accept responsibility for what happens politically in their community. Citizens are the ultimate source of legitimate authority in a democratic republic and thus bear a responsibility to govern themselves. This responsibility not only includes instructing elected representatives as to basic policy directions in which the public wishes to proceed but also acting with other citizens to establish the public's position on issues, environmental or otherwise.

In order to be able to actively participate in this manner, citizens must have both training and experience in citizen action. A rationale for citizen action education appears in Figure 10.

Democracy is not, after all, a spectator sport.
—Keith Melville

■ Figure 10

A Rationale for Citizen Action Education

Reprinted with permission from *Skills in Citizen Action: An English-Social Studies Program for Secondary Schools* by Fred M. Newmann, T.A. Bertocci, and R.M. Landsness. Skokie, IL: National Textbook, 1977.

- The purpose of citizen action education is to teach citizens (students) to function in a particular relationship with the state.
- The most desirable relationship between citizens and the state is that outlined in the structure of a constitutional, representative democracy.
- The major way in which this relationship differs from others is that the state belongs to its citizens, and citizens have an unalienable right to influence what the state shall do.
- Therefore, a primary educational mission must be to teach citizens to exert influence in public affairs, for without the competence to influence the state, the unalienable right to do so cannot be exercised.

An urgent need for citizen action on environmental issues emerged in the second half of the twentieth century. Citizens became involved in local or regional issues such as waste disposal, historic building preservation, urban and regional planning, and more global issues such as acid deposition, nuclear war, and tropical rainforest deforestation. To be an effective force in dealing with such issues, many citizens had to learn needed skills as they worked toward the solution of issues. These skills might have been acquired in formal school programs but many citizens

The success of any democratic society relies on the ability of its individual members to understand, and collectively solve, the society's problems. History teaches that whenever the power to make important human moral and ethical decisions is concentrated in the hands of a few, a diminished quality of human life cannot be far behind.
—Peter F. DeDecker

did not become involved because they lacked such skills. The study of local, regional, national, and global issues like those above serve as excellent vehicles for teaching citizen action skills in formal school programs. Of course, instruction in citizen action should not be totally environmentally oriented, but environmental issues are so numerous and pervasive today that they should receive considerable attention in such programs.

In a formal education program, responsibility for developing citizen action skills varies with grade level.

Lower Elementary

The emphasis at this level should be on helping students to develop generic skills that will form a solid basis for the development of specific citizen action skills in middle and senior high school. These generic skills include

- literacy skills, such as reading, writing, speaking and listening;
- map and globe skills, such as being able to use the cardinal directions, interpret map-key symbols, and make inferences about land use;
- research skills, such as collecting, organizing, and presenting data in graphic form;
- problem-solving skills, such as identifying alternatives and their consequences;
- interpersonal skills, such as being able to understand various points of view and to resolve conflicts; and
- information gathering and processing skills, such as those identified in the discussion of the perceptual awareness subgoal.

. . . Education, the art of teaching someone how to think, is not compatible with argument, the art of persuading someone to think you are right.
—Walter Purdy

Although these generic skills should be emphasized in the lower elementary grades, this does not preclude providing lower elementary students with citizen action experiences appropriate for their age and maturity levels. The teacher must be careful, however, to avoid indoctrination on environmental issues chosen for action. The issue or issues selected for action should not be pet concerns of the teacher; they should be concerns expressed by students. They also should be as local as possible so that students can actually see the results of their efforts.

Upper Elementary

The development of the skills identified for emphasis at the lower elementary level should continue at the upper elementary level. There are two competencies that should receive special attention at this level.

- The ability to communicate effectively. This includes receiving and providing information, ideas, and values by listening, speaking, gesturing, reading, writing, and using graphical representations and art forms. This competency is an important objective of all education. The more competent citizens become in communicating, the more effectively they will be able to participate in the resolution of environmental (and other) issues.
- The ability to work both independently and cooperatively. While the prevailing image of a "responsible citizen" is one who votes regularly or

writes letters about issues to elected officials, group action tends to be much more effective. Students must learn to work within groups in selecting and trying to resolve issues, to develop mechanisms for governance and the division of labor, to elicit cooperative alliances with other groups, to generate solidarity and commitment to purpose within a group, to receive and react to criticism, and to fulfill the genuine individual needs of group members.

As in the lower elementary level, the emphasis on developing generic skills does not preclude providing students with citizen action experiences appropriate for their age and maturity levels. But the same cautions apply, the issues should be those that concern students and not necessarily the teacher, and they should be as local as possible.

I think that in high school we have been exposed to the problems, but we have not had enough discussion on how to deal with them—or how to solve them.
—17-year-old high school student

Middle/Senior High School

At this level the emphasis should shift from helping students develop generic skills and competencies to using them as a basis for the development of specific citizen action skills. The best vehicle for doing this is the study of environmental issues. Instruction at this level should be directed toward helping students develop the following abilities.

Identify and clearly state environmental issues. An environmental problem is a negative impact on the environment that needs to be corrected. An environmental issue arises when individuals and/or groups hold opposing points of view on how the problem should be corrected. Students must learn how to make a clear statement of an issue.

Identify alternative solutions to issues recommended by individuals and/or groups, propose alternative solutions, and evaluate these proposed solutions for the value perspectives they represent. People have opposing viewpoints on issues because they possess different value orientations. Students must be able to identify these viewpoints and the value perspectives they represent.

Evaluate alternative solutions for specific issues with regard to their ecological and cultural implications. Each alternative solution has ecological and cultural impacts that must be identified and evaluated. This is an important skill for students to gain.

Use secondary sources of information in investigating environmental issues. Most issues and solutions arising locally have counterpart issues and proposed solutions elsewhere that have been investigated and recorded in print. Students must learn to write letters to and/or interview experts, use library and media reference systems, and record notes on information obtained. Being able to determine what is already known on an issue eliminates the need for extensive original investigative activity.

Use primary sources of information in investigating environmental issues. Surveys, questionnaires, and opinionnaires are important basic social science research methods used to collect data on a public's percep-

tion of an environmental issue. Students must understand and be able to select a strategy appropriate to an issue, select a sample population, and identify an appropriate data collection technique.

Natural science research methods also may be useful in collecting *data that will have an impact on the resolution of environmental issues.* Students must learn to recognize the need for additional technical data or information, to design a study to collect the needed data, and to implement the study.

Recognize and satisfy the need for additional knowledge about an issue. Students at this level who have participated in a well-organized environmental education program should have a solid knowledge base to help them understand many environmental problems and issues. But specific problems and issues may disclose a need for additional knowledge or a greater depth of understanding of specific concepts and principles.

Analyze data collected from both primary and secondary sources. Four skills needed by citizens investigating environmental issues are formulating logical conclusions, inferences, and recommendations based on data; graphing; communicating; and revising recommendations in light of new data. Students must develop these skills.

Identify one's own value positions related to specific issues and the alternative solutions proposed for them. Citizens who have progressed this far in investigating an environmental issue must now decide where they stand in order to develop an action plan aimed at resolving the issue.

'Being ready' means that the student knows how to combine . . . knowledge and values to make a decision. That process should be in place by the time a student graduates from high school.
—Peter DeDecker

Plan individual or group action for the purpose of resolving or assisting in the resolution of specific issues. There are several action strategies from which citizens can choose in putting together an issue resolution action plan. They include: persuasion, consumerism, political action, legal action, and ecomanagement. These will be discussed in greater detail in the following discussion of the citizen action experience subgoal. Students should be provided opportunities in which they experience each of the strategies and learn which is most effective in different situations.

An outline of the Taxonomy of Educational Objectives: Cognitive Domain: Knowledge was provided in the discussion of the knowledge subgoal (Figure 3). Many citizen action skill objectives are related to that level of the taxonomy, but many more are related to levels dealing with intellectual abilities and skills. In Figure 11, illustrative learner outcomes related to these upper levels of the taxonomy are provided.

Figure 11

Taxonomy of Educational Objectives: Cognitive Domain: Intellectual Abilities and Skills

Adapted with permission from *Taxonomy of Educational Objectives: The Classification of Educational Goals: Handbook I: Cognitive Domain*, by Benjamin S. Bloom, ed. New York: David McKay Co., Inc., 1956.

Illustrative Learner Outcomes for Citizen Action Skills

2.00 Comprehension

2.10 Translation

The student will

- prepare an abstract of an article on acid deposition.
- prepare a graph of recorded data collected by means of a survey instrument.

2.20 Interpretation

The student will

- interpret a graph of recorded data collected by means of a survey instrument.
- distinguish among warranted, unwarranted, or contradicted conclusions drawn from a body of data.

2.30 Extrapolation

The student will

- recognize the limitations of a body of data and formulate accurate inferences and tenable hypotheses.
- differentiate between value judgments and predictions of consequences.

3.00 Application

The student will

- predict the probable ecological impact of a change in an environmental factor (for example, deforestation on an ecosystem previously at equilibrium).
- apply the principles of democratic group action to participation in attempts to resolve an environmental issue.

4.00 Analysis

4.10 Analysis of elements

The student will

- recognize unstated assumptions in reading an article on an environmental issue.
- distinguish a conclusion drawn from expert testimony given during a hearing on an environmental issue from statements that support the conclusion.

4.20 Analysis of relationships

The student will

- analyze the relationship of statements made in a hearing on an environmental issue in order to distinguish relevant from irrelevant statements.
- check the consistency of a hypothesis of the reason for an environmental problem with given information and assumptions.

4.30 Analysis of organizational principles

The student will

- recognize techniques used in persuasive materials, such as printed advertising or television commercials, that mislead readers or viewers into believing some product is environmentally safe.
- recognize the point of view or bias of an author of a paper on an environmental issue.

5.00 Synthesis

5.10 Production of a unique communication

The student will

- prepare a report on a personal investigation of an environmental issue using an excellent organization of ideas and statements.
- make an extemporaneous speech on a personal environmental experience.

5.20 Production of a plan or proposed set of operations

The student will

- integrate the results of an investigation of an environmental issue into an effective plan to resolve the issue.
- propose ways of testing the hypothesis about the cause of an environmental problem.

5.30 Derivation of a set of abstract relations

The student will

- formulate a hypothesis about the cause of an environmental problem based upon the analysis of factors involved and modify the hypothesis in light of new factors and considerations.
- create a plan, using elements of good design, to improve the aesthetic appeal of the school site and to increase its usefulness as an outdoor laboratory for teaching ecological concepts.

6.00 Evaluation

6.10 Judgments in terms of internal evidence

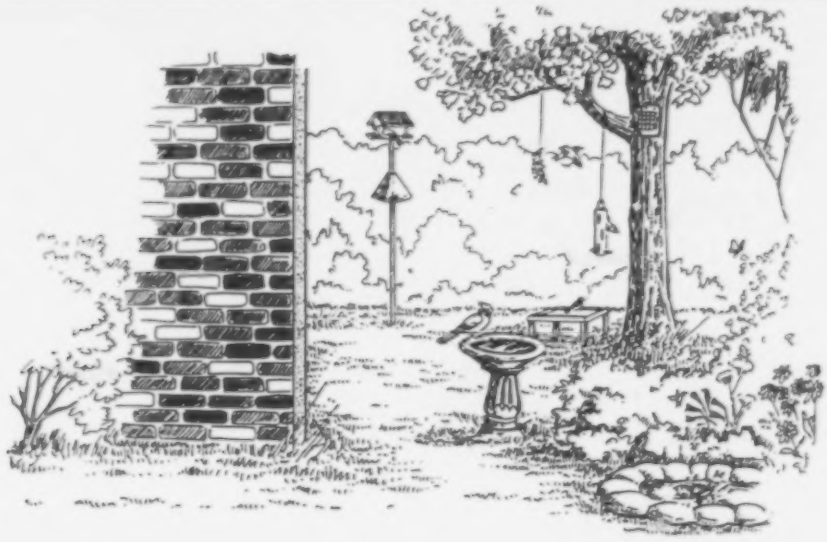
The student will

- use criteria in the suitability of various uses of land to evaluate a zoning master plan for a community.
- identify logical fallacies in testimony on an environmental issue given at a public hearing.

6.20 Judgments in terms of external criteria

The student will

- recognize and weigh values involved in alternative courses of action.
- distinguish between technical terminology that adds precision to a paper on an environmental issue by permitting a more appropriate definition of terms and that which merely replaces a common name with an esoteric one.



Subgoal: Citizen Action Experience

To help students gain experience in applying acquired perceptual awareness, knowledge, environmental ethic, and citizen action skills in working toward the prevention and resolution of environmental issues at all levels, local through universal.

Instruction directed toward achieving the subgoals of perceptual awareness, knowledge, environmental ethic, and citizen action skills is critical to the education of every citizen. But there is no guarantee that an individual who has experienced instruction in these four subgoals will become an effective member of society. In a sense, these four subgoals constitute a "driver's manual" for environmental citizenship. However, an instructional program that provides "behind-the-wheel" experience, real-world experience, in attempting to resolve environmental issues also is needed. Environmental issues arise because different groups of people identify different kinds of values as being important, and thus controversy arises. Controversy is inherent in a free democratic society, and in the past many educators have promoted the discussion of controversial issues as being essential to education for citizenship. But much more than a discussion of controversial issues is needed. Students must be provided instruction and experiences in the identification, investigation, and resolution of environmental issues in their own community.

These experiences should include: utilizing various methods of citizen action; analyzing situations to determine if action is wise and warranted; and evaluating the effectiveness of actions taken.

. . . We must develop in our young people the willingness and the intellectual abilities to come to grips with intractable problems; we must give them the tools to gather and analyze data; we must help them explore the values and cultural mindsets of their childhood upbringing, rendering them free enough to assess the validity of what they have learned in the past for whatever their futures may be. Most of all, we must bring them into the reality of government, giving them firsthand experience and significant involvement . . . .
—Wilma Longstreet

Methods of Citizen Action

Harold Hungerford and his associates at Southern Illinois University have identified five widely used methods of citizen action that students should study and experience.

Persuasion: A logical or emotional appeal to motivate other human beings to modify their values and take positive environmental action (for example, posters, newspaper articles, advertisements, radio/television announcements, verbal discussions, speeches, letter writing, debates, newspaper articles, magazine articles, and modeling behavior).

Consumer action: Primarily economic actions intended to motivate other human beings to take positive environmental actions.

- Direct boycott: Applying economic pressure by refusing to buy products with a negative environmental impact in order to eliminate their production (for example, refusing to buy nonrecyclable beverage containers).
- Indirect boycott: Applying economic pressure by refusing to buy products produced by an individual or company that engages in an action unrelated to the products but that has a negative environmental

impact (for example, refusing to buy Japanese-made products because the Japanese harvest endangered whales and rainforest lumber).

- Conservation: Reducing consumption of a product that despite its having a negative environmental impact in its production and/or use is also needed by people (for example, electrical energy).
- Monetary and volunteer support: Contributions of money to or doing volunteer work on behalf of individuals, organizations, or institutions actively working for consumer action as a means of maintaining and enhancing environmental quality (for example, donations and/or membership fees paid to an organization promoting energy conservation or participating in an unpaid volunteer telephone bank).
- Economic patronage: Buying certain products because the company producing them attempts to reduce or eliminate negative environmental impacts in their production (for example, recycled materials are used or plastic wrapping is replaced with paper wrapping).

The study of environmental problems is an exercise in despair unless it is regarded as only the preface to the study, design, and implementation of solutions.
—David W. Orr

Political action: An action to persuade an electorate, elected official, or executive governmental agency to conform to the values held by the person or persons taking that action (for example, voting, campaigning, lobbying, running for office).

Legal action: Any coercive legal/judiciary action taken by an individual and/or organization that is aimed at some aspect of environmental law enforcement or a legal restraint of some environmental behavior perceived as undesirable (for example, lawsuits, injunctions).

Ecomanagement: Positive physical action by an individual or group that improves or maintains some part of the environment (for example, ecosystem restoration, nature trail development, starting a recycling center).

In acting on a specific environmental issue, citizens often employ more than one of these forms of action.

Deciding if Action Is Warranted

Once students have had the opportunity to explore citizen action methods and learn in what kind of situations each is most effective, they should be provided opportunities to develop action plans for issues they have investigated. The following list of questions outlined by Hungerford and his associates provides a guide for evaluating their action plans in order to determine if implementation is warranted.

- Is there sufficient evidence to warrant action at this time?
- Are alternative actions available?
- Is the action method chosen the most effective one?
- What are the legal consequences of this action?
- What are the social consequences of this action?
- What are the economic consequences of this action?
- What are the ecological implications of this action?
- Are my values consistent with this action?

- Do I understand the procedures necessary to take this action?
- Do I have the time needed to complete this action?
- Do I have the courage to take this action?
- Do I have the resources needed to make this action effective?
- Do I have the skills needed to take this action?

The answers to these questions should provide a basis for deciding if a citizen action plan should be immediately implemented, delayed, abandoned, or modified.

Evaluating the Effectiveness of Actions

Evaluating the results of an implemented action plan may be difficult because of several reasons.

- The issue is not local enough to provide readily observable results of actions taken. For example, if the action was raising funds to be used in curtailing rainforest destruction in Indonesia, the impact of the action may not be easily confirmable. Students may have to be satisfied with the organization's general annual report that a certain number of acres of rainforest were protected during a particular year.
- The nature of the actions taken may be such that a considerable time period must pass before the impacts of the action are observable. For example, if the action was directed toward stream restoration, and included reducing the discharge of substances detrimental to aquatic life into a stream, a complete recovery of the stream may take years. Knowing that the sources of the discharges have been eliminated and assuming that the stream will eventually return to a more natural state may be the only immediate measure of successful action.
- The impact of the actions taken may not be as complete as the students expected. For example, if the student action was directed toward eliminating the spraying of pesticides on lawns in a community, and the city council refused to do so but enacted an ordinance requiring a 72-hour posted notice of intent to spray and a notice that spraying had taken place, the action may be judged to have failed. But in reality, a substantial partial success has been achieved. Students must be helped to understand that often the most that can be expected is a partial victory and that a continuation of the original action or a new action strategy may be required.

The above reasons provide support for the use of local issues in teaching citizen action skills and in providing citizen action experience.

The discussion of the relationships of the citizen action skills subgoal to the Taxonomy of Educational Objectives: Cognitive Domain (Figure 11) also pertains to this subgoal. Several of the illustrative learner outcomes provided in that discussion clearly deal with implementing action plans.

One of the key goals of citizenship education is to help students appreciate the complexity of social problems and the futility of simple solutions.
—Robert B. Woyach and Richard C. Remy

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Theoretical Base 4

Introduction
Developmental Theory
Behavioral Theory
Holistic Theory
Applying Research Results
Summary
References

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Introduction

Educational programs and curricula should be developed in response to three concerns: the physical, intellectual, moral, and ethical development needs of human beings; the need to fulfill social responsibilities; and the need to understand the content of the various disciplines. Theoretically, these three concerns should not be in conflict, but in planning programs and curricula they frequently are, and most commonly sacrificed in this conflict is the concern for human development. A special effort must be made to avoid this sacrifice. The fulfillment of human growth needs of students should never be subordinated to the fulfillment of societal needs or the demands of disciplines. Environmental education, like all education, should conform to known development patterns of students.

Research regarding the growth and development of children provides a basis for structuring curricula and programs dealing with environmental education. Since environmental education is a relatively new concern, it has had the advantage of being able to use the wealth of recent research on learning and behavior. The first part of this section reviews educational theory and research results that are proving to be a major influence in curriculum planning, program development, and methodology in environmental education. They are grouped into three topic areas: developmental theory, behavioral theory, and holistic theory. The last part of this section applies relevant aspects of each theory to the subgoals of environmental education, resulting in models useful in program planning.

Developmental Theory

. . . The first job of our elementary schools today should be to strengthen the thinking foundation on which any particular learning is grounded. To do this administrators, teachers, and society at large must come to a fuller understanding of the child's mind.
—Hans Furth

A developmental theory is one that presumes that levels or stages can be identified as an individual matures intellectually. Those important to environmental education include: Piaget's cognitive development theory, including the work of Epstein and Toepfer on brain growth periodization; constructivist learning theory; Piaget's and Kohlberg's moral development theories; and Gilligan's modifications of Kohlberg's model.

Piaget's Cognitive Development Theory

The best-known research on cognitive development is that of Jean Piaget. His research identified cognitive developmental stages an individual might progress through from birth through adolescence (Figure 12). This theory has been subjected to considerable research and examination and there exists a substantial amount of data to support its major points. Additional research, such as that by Patricia Arlin, suggests a modification of Piaget's Formal Operational Stage, also shown in Figure 12.

Figure 12 ■

Piagetian Intellectual Development Stages

Developmental Stage	*General Age Range*	*Characteristics of Children*
Sensorimotor	Birth to approximately 18 months	• Preverbal • Objects exist only when in the perceptual field of the child • Hidden objects are located only through random physical search • Practical basic knowledge develops which forms a substructure for later representational knowledge
Preoperational	18 months to 7-8 years	• Organized language and symbolic function begins, thought and representation develop • Perceptually oriented, does not use logical thinking, cannot reason by implication • Directed by simple goals, activity includes crude trial and error corrections • Cannot coordinate variables, has difficulty in recognizing multiple properties of objects, often satisfied with multiple, sometimes contradictory explanations • Lacks operational reversibility in thought and action
Concrete Operations	7-8 years to 11-12 years	• Thinking becomes concrete but not abstract, however, elementary logical operations can be performed, and elementary groupings of classes and relations can be accomplished • Concepts of conservation develop in order of number, substance, length, area, weight, and volume • Concept of reversibility develops • Cannot isolate variables, proceeds from step to step in thinking without realizing relationship between them
Propositional or Formal Operational	11-12 years to 14-15 years	• Formal abstract thought ability begins to develop, marked by appearance of hypothetical—deductive reasoning based upon logic of all possible combinations, development of combinatorial system and unification of operations into a structured whole
Arlin's Fifth Piagetian Stage	14-15 years and up	• Ability to perform controlled experimentation develops, keeping all but one factor constant • Ability to hypothesize variables before experimentation, to reverse direction between reality and possibility, develops • Can use interpropositional operations, combining propositions by conjunction, disjunction, negation, and implication

If we present a child with learning tasks prior to the myelination of the areas needed to handle these tasks, we may be forcing the child to less appropriate neural networks. By asking the learner to perform before the appropriate area is developed, we may be causing the failure and frustration seen in many children today.
—Virginia Johnson

The results of research by Herman Epstein and Conrad Toepfer, Jr. in the area of brain growth periodization provide a physiological confirmation of Piaget's findings. Their work can be summarized as follows.

- The brain grows in a stagewise fashion, with spurts occurring for most children between the ages of 3-10 months, 2-4 years, 6-8 years, 10-12 years, and 14-16 plus years.
- Plateaus in brain growth occur between the ages of 10 months-2 years, 4-6 years, 8-10 years, and 12-14 years.
- The first four brain growth stages coincide with the onset of the classic Piagetian stages. The last brain growth stage coincides with the fifth Piagetian stage identified by Arlin.
- During brain growth periods, new facts and information can be learned when attached to the learning of appropriate new and higher level thinking skills.
- During plateau periods, new facts and information can be learned by utilizing the skills initiated during previous brain growth periods, thus aiding in the maturation of these new skills before progressing to another new, higher skill level.
- In some children, brain growth periods are short relative to those of other children; therefore, plateau periods also vary in length.
- Growth periods and plateaus do not occur in all children at the same time; therefore, it is important to identify when they occur in individuals in order to plan responsive learning environments during these stages.

The correlation between Piaget's stages and Epstein's and Toepfer's brain growth periods is portrayed in Figure 13. An additional element of Figure 13 is the relationship between the work of Piaget, Epstein, and Toepfer and the usual grade level for individuals of a certain age.

Constructivist Learning Theory

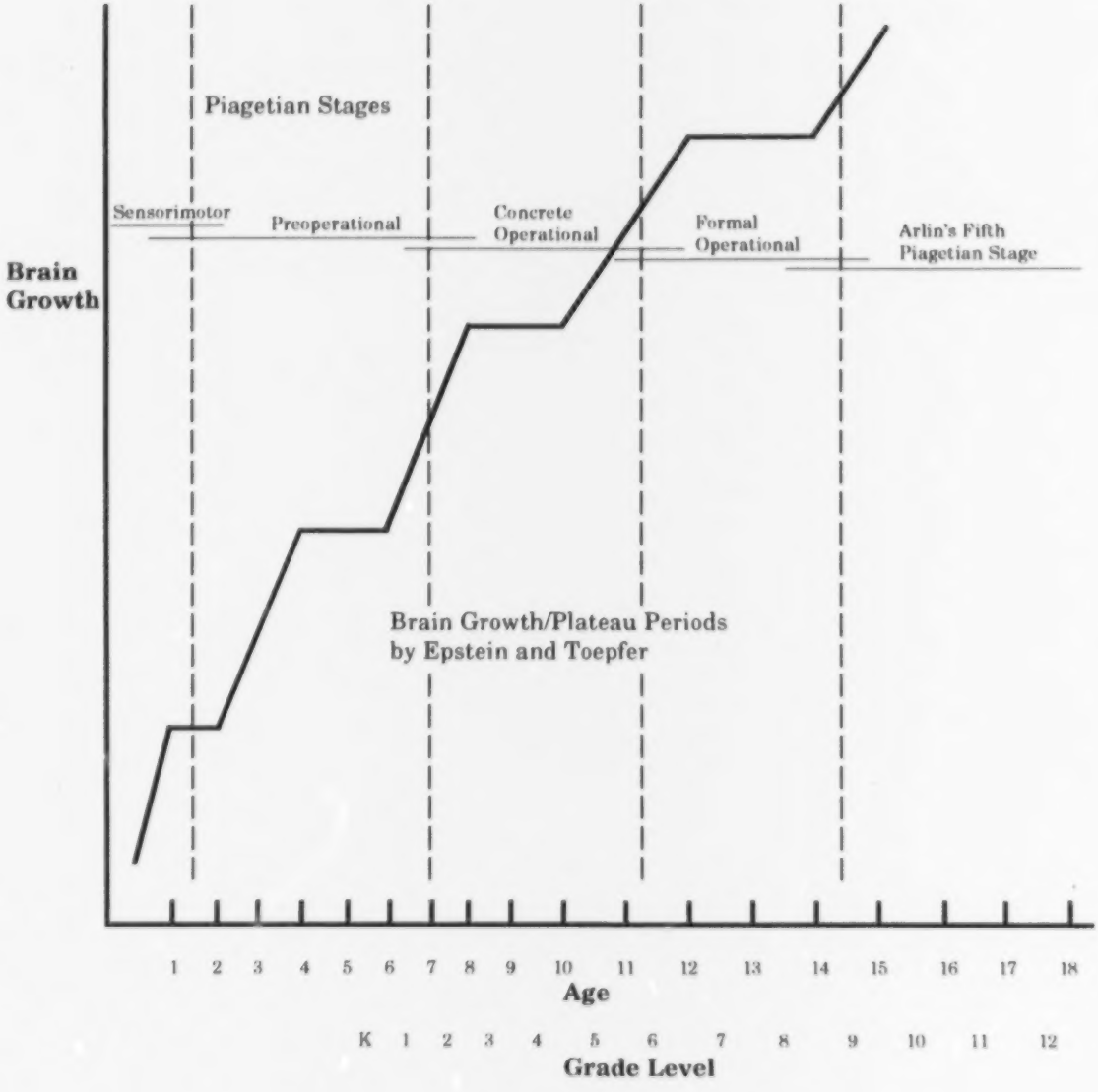
Jean Piaget was an early promoter of the idea that knowledge is constructed (learning occurs as a result of dynamic interactions between individuals and physical and social environments). In his book *Piaget's Theory of Cognitive and Affective Development 4/e* (copyright © 1989 by Longman Publishing Group), Barry J. Wadsworth explains the Piagetian interpretation of knowledge construction.

"American educational practice is generally based on the premise that knowledge is something that can be directly transmitted from teachers and books to students. When knowledge is not acquired, there is assumed to be a problem with the student.

"Possibly the most important and revolutionary implication of Piaget's theory is that children *construct knowledge* from their actions on the environment. Physical knowledge is constructed through actions on objects. Legitimate concepts of trees can only be acquired from, and elaborated upon by, children 'acting on' trees. Pictures of trees, stories of trees, and reading about trees cannot develop a complete knowledge of trees in young children. Logical-mathematical knowledge is constructed from actions on objects when the most important component is

Figure 13

Correlation Between Piagetian Stages and Brain Growth Periods


Piagetian Stages
Sensorimotor
Preoperational
Concrete Operational
Formal Operational
Arlin's Fifth Piagetian Stage
Brain Growth
Brain Growth/Plateau Periods by Epstein and Toepfer
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Age
K 1 2 3 4 5 6 7 8 9 10 11 12
Grade Level

the child's action, not the particular object. Number, length, and area concepts cannot be built up from hearing about them or reading about them. The construction of social-arbitrary knowledge is dependent on the child's action on, and interaction with, other people. Again, the form of knowledge cannot be directly transmitted through words or symbols, it must be constructed.

"For educators, the implication is clear. If an objective of education is to enhance children's acquisition of knowledge, educational methods need to be consistent with how children acquire knowledge. Many children do not 'learn' because they literally cannot understand what they are being asked to learn."

Important elements of constructivist learning theory, drawing upon the research of several investigators, include:

- Learners construct knowledge, they do not discover it. Discovery is merely one kind of activity used to construct knowledge.
- Knowledge construction, or learning, begins with observations of objects or events.
- Knowledge construction, or learning, is an individual event for which the learner must accept responsibility, a responsibility that cannot be shared.
- The knowledge that is constructed, that which a learner learns, is dependent upon what the learner already knows and the learner's cognitive self-esteem, the belief in one's ability to learn.

Learning is something that individuals must do by and for themselves.
—Hans Andersen

In terms of the Taxonomy of Educational Objectives: Cognitive Domain, knowledge construction seems to proceed in the manner described in Figure 14.

Piaget's and Kohlberg's Moral Development Theories

Piaget recognized a close relationship between cognitive and moral development and conceived a moral development model with the general age ranges of its stages closely paralleling those of his cognitive development model. Lawrence Kohlberg further defined Piaget's model, maintaining that moral development is a long-term process involving movement through three levels divided into six stages. Movement from one stage to the next is stimulated as an individual recognizes his or her own inadequacies of reasoning or the presence of cognitive conflict at a current stage of reasoning and the greater adequacy of another higher level of reasoning. Each of the six stages has respective motives for complying with moral rules. Piaget's and Kohlberg's Moral Development Theories are outlined in Figure 15.

Figure 14

Knowiedge Construction and the Taxonomy of Educational Objectives: Cognitive Domain

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	Level	*Nature of Learning Activity*
1.00	Knowledge	Learner acquires terminology, facts, and so forth by listening or reading. The learner is like a container that the teacher tries to fill.
2.00	Comprehension	Learner acts on information received—translates, interprets, or extrapolates it. Information becomes the learner's, thus increasing the likelihood of retention.
3.00	Application	Learner recalls and uses information to solve a new problem in a new situation. As competence in doing so increases, the learner's cognitive self-esteem rises, thus further motivating the learner.
4.00	Analysis	Learner relates what is known to other things known, breaking down what is known into its elements.
5.00	Synthesis	Learner relates what is known to other things known, arranging and/or combining elements of knowledge to create new patterns or structures.
6.00	Evaluation	Learner draws everything known together and uses the relevant knowledge to solve a problem.

Figure 15

Moral Development Theories

Piaget's Model of Moral Development

Adapted from *The Moral Development of the Child* by Jean Piaget, New York: Free Press, 1969.

Stage	General Age Range (Years)	Characteristics of Children
Motor and Individual	Birth - 2	Child acts according to own desires and motor habits
Egocentric	2 - 6	Child uses accepted rules and imitates them but does not respect them or apply them in interaction with others
Authoritarian	7 - 11	Rules obeyed because they come from authorities—older children and adults. Adherence to rules viewed as necessary to winning
Consensus	12 and older	Rules determined by consensus. Autonomy from parents and other sources of moral authority is achieved

Kohlberg's Levels of Moral Development

Adapted from *The Philosophy of Moral Development: Moral Stages and the Idea of Justice, Vol. 1* by Lawrence Kohlberg, San Francisco: Harper and Row, 1981.

Level	Approximate Age Range (Years)	Stage Number/ Orientation	Motivational Characteristics
Pre-conventional: Self-centered needs	7-10	1. Punishment/ Obedience	Acts in a certain way to avoid punishment by authority
		2. Instrumental/ Relativist	Concern based on a desire to satisfy own needs, occasionally those of others
Conventional: Conformity to traditional role expectations, maintenance of existing social and legal order	10-13	3. Interpersonal Concordance	Pleases others by good behavior; conforms in order to avoid social or peer disapproval
		4. Law and Order	Acts according to norms, unwritten rules of society; believes one must show respect for authority
Post-conventional: Decisions based on values shared by others rather than self-centered or blind interests	13- adult	5. Social Contract	Sensitive about infringing on rights of others, violating arbitrary rules made by peers
		6. Universal Ethical Principle	Respects values and attitudes of others but relies heavily on own intellect and values in making personal decisions

Kohlberg believes that the stages

- are organized systems of thought, that individuals are consistent in their level of moral judgment.
- form an invariant sequence. Movement is always forward except under extreme traumatic conditions. Stages are never skipped. Movement is always to the next stage.
- are hierarchical integrations where higher-stage thinking includes within it lower-stage thinking, and there is a preference to function at the highest stage available to the individual.

This developmental structure seems to be universal across cultures.

Gilligan's Modifications of Kohlberg's Model

Because Kohlberg's subjects were all male, his theory of moral development is biased toward a male-oriented ethic. As males develop morally, they tend to view life as a competition they are expected to win, and they judge according to an ethic of justice—people treating one another fairly by living up to the rules, principles, rights, and duties they share. Carol Gilligan, a Kohlberg associate, studied the differences in moral development between males and females. She found that as females develop morally, they tend to view life as an opportunity to create, cherish, and preserve interpersonal connections. Females judge according to an ethic based on establishing and preserving relationships with other individuals and with the rest of the world, while providing concomitant care within those relationships, she found. The female view of morality and the central theme of environmental education—that all people are part of and interdependent with Earth and all of its inhabitants, human and otherwise—are very similar.

Michael Caduto proposes an integration of the male and female views of life as a basis for environmental education programs. He points out that initially males and females tend to develop morally in a similar fashion, following the first three stages of Kohlberg's model. But at this point, males tend to develop with the justice orientation described by Kohlberg in stages 4-6 of his model, and females with the caring relationship orientation described by Gilligan. He urges educators to recognize these differences and to foster the important aspects of being in relationships—living in a loving, compassionate way with other people and Earth—in both males and females. Caduto emphasizes the need for educators to be alert to the transition from Kohlberg's Stage 3 to Stage 4 to determine whether the child is tending toward Kohlberg's Stages 4-6 justice-based morality or toward one based on relationships, and to plan curriculum and instruction accordingly.

Behavioral Theory

Behavioral theories are based on the perspective that human behavior is motivated by both negative and positive stimuli. Proponents of behaviorist theory, such as B.F. Skinner, contend that, to a large extent,

behavior can be directed by providing appropriate incentives or disincentives. For example, a child is more likely to engage in a positive environmental action (such as litter pickup) if there is some concrete reward for that effort (such as extra recess). Adults, being able to deal with the more abstract, may pursue pro-environmental behavior if they see the payoff as maintaining or improving their quality of life.

Locus of Control

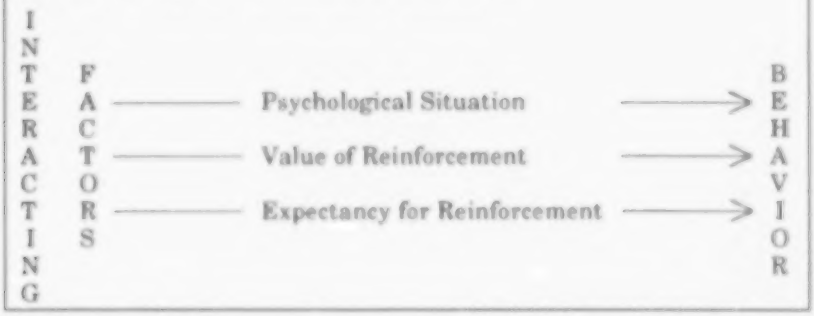
An extension of behavioral theory is found in the conceptual application of what is known as locus of control, a specific attitudinal variable affecting the behavior of an individual due to his or her perception of control over a situation (for example, an environmental issue). This perceived belief about personal control, or lack thereof, over the situation was first introduced as a component of J.B. Rotter's Social Learning Theory, which was developed in an effort to explain the social behavior of psychotherapy patients. Since its introduction, considerable empirical evidence has been established supporting the utility of the locus of control theory for explaining human behavior.

Rotter's Social Learning Theory (Figure 16) states that a person's actions or behaviors are a function of three equally interacting factors: the psychological situation; the value of reinforcement(s); and the expectancy of reinforcement. Important definitions associated with these factors include:

- psychological situation: The accumulation of cues that might directly affect the expectancies and reinforcement values of an individual.
- reinforcement: Anything that affects the occurrence, direction, or kind of behavior.
- value of reinforcement: The degree of preference for a particular reinforcement to occur if all possible reinforcements were equally possible.
- expectancy for reinforcement: The probability held by an individual that a particular reinforcement will occur as a function of a specific behavior on his or her part in specific situations.

Figure 16

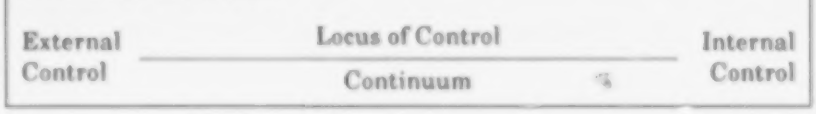
Rotter's Social Learning Theory



Locus of control is a dimension of expectancy for reinforcement. Some individuals perceive that an event is not entirely contingent upon their behavior but results from luck, chance, fate, the control of others with power, or a great complexity of forces acting on the situation—a belief in external control. Other individuals perceive that an event is almost totally contingent upon their behavior or their own relatively permanent characteristics—a belief in internal control (Figure 17).

Figure 17

Locus of Control



Actually, most individuals perceive that an event is affected by both internal and external factors, and they would locate themselves somewhere on the continuum of Figure 17 other than at one of the extremes.

Within an individual, locus of control has been shown to operate as both a generalized expectancy covering many diverse situations and a specific expectancy directed toward a group of similar situations. When confronted with a novel or ambiguous situation, an individual usually behaves in terms of a generalized expectancy, but when confronted with a familiar situation, an individual usually behaves in terms of a specific expectancy. Other research about locus of control suggests that:

- family environment, consistency of parental reinforcement, and ordinal position in the family affect an individual's locus of control. A warm, supportive, nurturing environment encourages internality; earlier-born children in large families tend to be more internal than later-born children.
- locus of control is relatively consistent when measured over short durations, but it may shift over longer periods. An increase in internality occurs with an increase in mental age.
- internal-control individuals more frequently participate in productive action-taking than external-control individuals.
- internal-control individuals have a greater ability to recall relevant material and more actively seek additional information than do external-control individuals.
- internal-control individuals are superior to external-control individuals in their utilization of information.
- internal-control individuals are more resistant to subtle manipulation and are less influenced by high-prestige individuals than are external-control individuals.
- internal-control individuals exhibit a greater capacity to delay gratification in order to attain greater, long-term goals than do external-control individuals.

Some individuals do not attempt to bring about desired change because they attribute change to chance or powerful others . . . rather than their own behaviors.
—R. Ben Peyton and Barbara Ann Miller

The development of one's perceptual senses requires more than exposure. It requires an openness, a willingness to experience, and the ability to use one's senses. Here are two roadblocks to success—the willingness of people to use their senses and their ability to do so. Some people, for example, are afraid of foreign environments, such as natural areas. Such fears develop from personal childhood experiences or from the teaching of others, usually their parents. These fears must be dealt with before such people can learn to use their senses to both detect problems in the environment and enjoy pleasant environments.
—James Swan

- internal-control individuals respond differently to those tasks that they perceive to be skill-related than to tasks they perceive to be chance-related.
- an individual's perceived locus of control may change because of new experiences.

Hungerford's and Volk's Environmental Behavior Model

Specific research by Hungerford, Volk, and others suggests locus of control as one of several factors, some of major significance and others of minor significance, that affect an individual's behavior in regard to the environment. Figure 18 reflects the relationships involved in positive environmental behavior.

Entry-level variables are those factors that stimulate an individual to become involved with environmental issues. Ownership variables are those that make issues very important at a personal level to the individual. Empowerment variables are those crucial to training citizens in order that they may act effectively.

Entry-Level Variables

Environmental sensitivity is defined as an empathetic perspective toward the environment. Several factors may contribute to the development of environmental sensitivity.

- frequent interaction with natural, rural, or other relatively pristine habitats, exploring or playing in the outdoors, alone or with one or two friends
- witnessing the degradation of one's habitat, of areas frequently visited, resulting in a feeling of loss of beloved open spaces
- family and nonfamily role models, especially teachers, who fostered and encouraged the development of environmental sensitivity
- having access to and reading nature-oriented books.

The average age at which a person appears to have acquired an environmental sensitivity is just more than 12 years, thus appropriate preschool and elementary school education programs have an important role to play. Environmental sensitivity seems to be one of the major contributors to positive environmental behavior.

A knowledge of ecology is almost always prerequisite to sound decision making on solutions to issues. In itself it does not lead to positive environmental behavior, but it does contribute to initiating action on environmental issues, although not as strongly as environmental sensitivity.

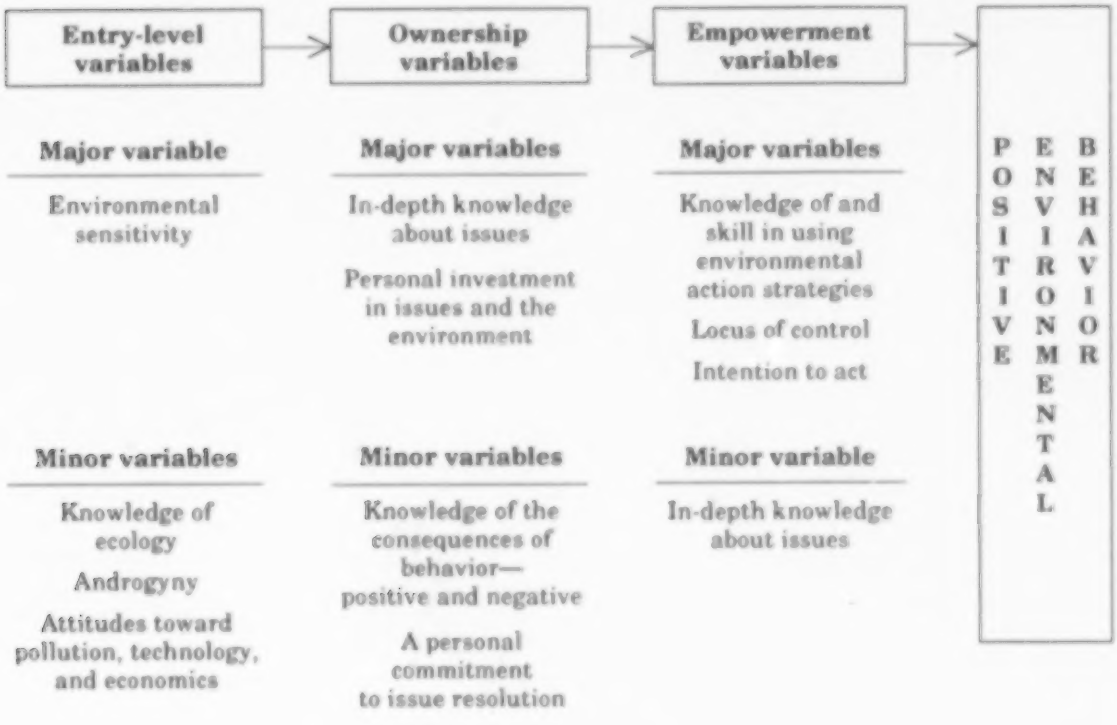
Androgyny refers to people who tend to reflect nontraditional sex-role characteristics (for example, males who cry in sad situations or females who demonstrate assertive behavior). Androgyny is often associated with individuals who are active in helping to resolve environmental issues, but it is not as strong a factor as environmental sensitivity.

Attitudes toward pollution, technology, and economics are variables that seem to be involved with behavior, but the extent of their involvement is not clear.

Figure 18

Major and Minor Variables Involved in Environmental Behavior

Adapted with permission from "Changing Learner Behavior Through Environmental Education" by Harold R. Hungerford and Trudi L. Volk, *Journal of Environmental Education* (Washington, DC: Heldref Publications) 21.3 (Spring 1990).



Ownership Variables

In-depth knowledge about issues seems to be extremely important as a contributor to ownership. The nature of the issue and its ecological and human implications must be understood before individuals can engage in responsible environmental behavior.

Personal investment in issues and the environment also appears to be of major importance in promoting positive environmental behavior. This investment may be economic in nature or a personal concern for the importance of not interfering with the ecological functioning of the environment.

Knowledge of the consequences of behavior—negative and positive—on the environment is not as important as the first two discussed but may persuade an individual to buy into an issue.

A personal commitment to resolve issues, a recognition of the need for appropriate ways to bring opposing viewpoints together, is another minor variable.

. . . Most educators firmly believe that, if we teach learners about something, behavior can be modified. In some cases, this is true. However, in educating for generalizable responsible environmental behavior, the evidence is to the contrary.
—Harold R. Hungerford and Trudi L. Volk

Empowerment Variables

Knowledge of and skill in using environmental action strategies is a two-part variable. The skill component seems to be the stronger factor than the knowledge component but is dependent upon it.

Locus of control, previously discussed in detail, appears to be interconnected with the other variables.

Intention to act increases the likelihood of an action occurring and may be related to the ownership variable, personal ownership.

In-depth knowledge about issues was identified previously as a major ownership variable. It also plays a less important role as an empowerment variable. Knowing about issues may add clout and empowerment, which otherwise might be missing.

Holistic Theory

Holistic theories also seem to play a significant role in the development of curricula and instructional programs for environmental education. These theories propose that there are many interacting physical and socio-psychological factors that work together to motivate or direct a person's behavior and ultimately have a significant effect on the individual's learning process. It is believed that as many of these factors as possible should be addressed during the educational experience of an individual, thus working toward developing the whole student.

Left/Right Brain Theory

Holistic approaches to education are based in part on the physical nature of the brain/mind system. The brain seems to have three functional information processing systems: the attentional system; the sensory system; and the intentional system. Each system functions

independently, affecting and being affected by the other systems, and each system functions differently during different stages of cognitive development. Figure 19 lists the functions of each of these systems and identifies the age range during which major development of the system takes place and the functions developing at that time.

Figure 19

Information Processing Systems of the Human Brain

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Attentional System (age: birth upward)

Problem-solving, Thinking, Reasoning

- attention
- perception
- memory
- language-speech
- voluntary action

Sensory System (age: 5-15 years)

left hemisphere	**right hemisphere**
referential	relational
logical	intuitive
classification	holistic
linear	spatial
sequential	pictorial
convergent	divergent
exclusive	inclusive
analysis	synthesis
either/or	multiple implications
right/wrong	creative
decision making	consequences of decisions

Intentional System (age: 15 upward)

Creation of Intent

- formulate plans of action
- monitor performance

— selective encoding of relevant information
— selective comparison of information
— selective combining of relevant information

- compare progress with original intent
- evaluate outcome

Figure 19 shows that from ages 5 to 15 there is major development of the left and right hemispheres. Figure 20 summarizes the kinds of information perceived by the two cerebral hemispheres. The left cerebral hemisphere functions mainly in relating things in time, performing acoustic analysis, decoding speech, and interpreting sequential or linear data such as mathematical computation, written language, and logical

thinking. The latter are linear because they have to possess a certain order to make sense. The left hemisphere enables an individual to perform the operations of language and sequential linear functions.

The right cerebral hemisphere operates much more holistically. It simultaneously senses and processes information. It is the center for visual and spatial interpretations, and it plays a major role in daydreams, fantasies, musical abilities, dancing, athletics, and intuitive creativity.

Because of prevailing Western social values the functions of the left-cerebral hemisphere have been celebrated. Right-cerebral functions have been demeaned. Children are required to have logical reasons for what they do.
—Bob Samples

Figure 20

Information Perceived by the Human Brain

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Left Cerebral Hemisphere	*Right Cerebral Hemisphere*
• abstract symbols	• visual images-pictures
• language-verbal	• language-verbal
— alphabet	— expression
words (spelling)	tone
sentences (syntax)	intonation
— reading	— body language
speaking	gestures
writing	facial expression
	— logos-pictorial symbols
• language-mathematical	• language-mathematical
— numerals	— spatial
operations (basic facts)	shapes
— computation:	— geometry
addition	shapes-relationships
subtraction	— patterns
multiplication	— relationships
division	
• logic	• creativity
• rhythm	• melody
• linear time	• time-cyclical
— seconds-minutes	— seasons
hours-days-weeks-years	
• definitions	• functions
• labels	• images-pictures

McCarthy's Learning Style Research

Research does not suggest that most people behave in such a way that they may be called purely right brain or left brain. Rather, they operate with the ability to integrate the specialized abilities contributed by each

cerebral hemisphere. However, individuals may show a preference for processing experience through a right or left hemisphere approach. But classroom instruction often focuses on left hemisphere capabilities and thus does not develop the whole person. In order to maximize the learning potential of each individual, instruction should include both left and right hemisphere approaches.

Closely associated with left/right hemisphere learning preferences is the idea that additional socio-psychological development of the brain/mind systems leads to the development of identifiable individual learning styles. Building on the work of numerous other investigators, Bernice McCarthy has identified four such learning styles (see Figure 21), the characteristics of which may be found in Figure 22.

McCarthy recommends that instruction involve all students in experiences appropriate to all four learning styles thus including both left and right hemisphere approaches. The integration of learning styles and left/right hemisphere approaches addresses individual learning preferences while working toward development of the whole learner.

Figure 21

McCarthy's Learning Styles

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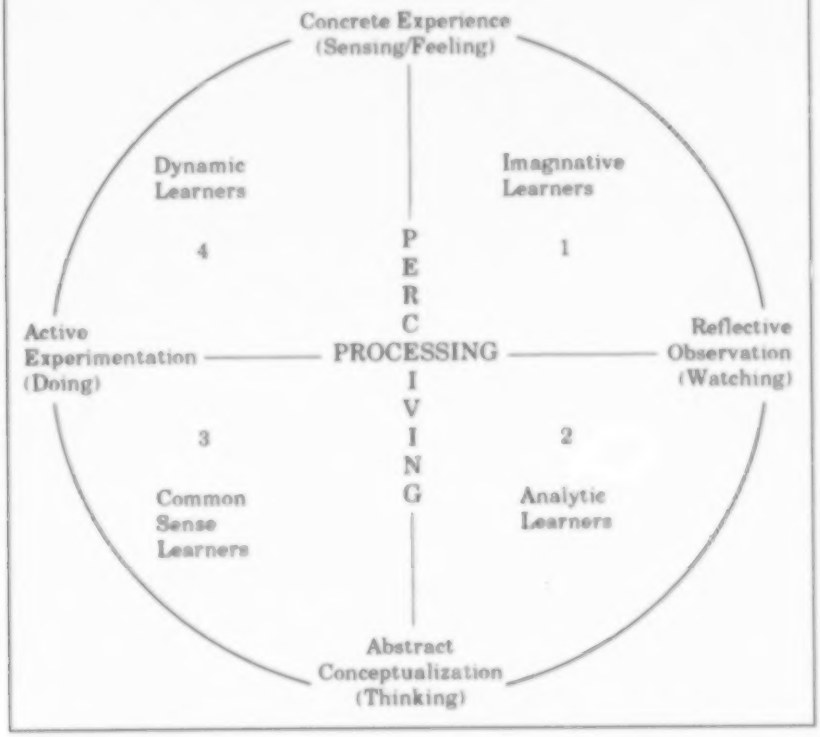

The sensor/feelers need to refine their intuitive gifts, while also learning to acquire the gifts of logic and analysis. And the thinkers need to refine their rational gifts, while also learning to trust the gifts of their senses, their intuitive abilities.
—Bernice McCarthy

Figure 22

McCarthy's Learning Styles

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Type	*Learner Characteristics*
One: Imaginative Learners (Perceives information concretely, processes it reflectively)	Seeks personal meaning Judges things in relationship to values Functions through social interaction Wants the world to be a better place Is cooperative and sociable Respects authority when it is earned, exercises it with participation and trust Learns by listening and sharing ideas Divergent thinkers Model themselves on those they respect Interested in people and culture Strength is innovation and imagination
Two: Analytic Learners (Perceives information abstractly, processes it reflectively)	Seeks intellectual competence Judges things by factual verification Functions by adapting to experts Needs to know "the important things," wants to add to the world's knowledge Is patient and reflective Interested in ideas rather than people Prefers chain-of-command authority Learns by thinking through ideas Leads by being brave and protective Values sequential thinking Strength is creating concepts and models
Three: Common Sense Learners (Perceives information abstractly, processes it actively)	Seeks solutions to problems Judges things by their usefulness Functions through kinesthetic awareness Wants to make things happen Is practical and straightforward Sees authority as necessary, but will work around it if forced to do so Exercises authority by reward and punishment Needs to know how things work Leads by inspiring quality Strength is practical application of ideas
Four: Dynamic Learners (Perceives information concretely, processes it actively)	Seeks hidden possibilities Judges things by gut reactions Functions by synthesizing various parts Enjoys challenging complacency Is enthusiastic and adventuresome, tends to take risks Tends to disregard authority Learns by trial and error, self-discovery Adaptable to change Often reaches accurate conclusions in the absence of logical justification Leads by energizing people Strength is action, carrying out plans

Research Into Affective Education

The results of research by numerous investigators show that knowledge does not exist apart from the attitudes, feelings, and emotions that make people open-minded rather than close-minded and responsible rather than irresponsible. Therefore, cognitive and affective factors must be considered holistically during the teaching/learning process. It is for this reason that a review of research into affective education, and its relationships to education about the environment, is included under the heading of holistic theory.

Some of this research suggests that the formation of values by children occurs in five stages, as indicated in Figure 23. These stages are not distinct, there is a gradual transition between them.

Remember to keep in mind your students' stages of moral development, and be sure to provide them with enough information to analyze the issues. —Charles R. Barman and Timothy M. Cooney

During the past 20 years, a large number of studies relating environmental education and the affective domain have been completed. Louis Iozzi has identified the major ideas suggested by this research.

- Environmental education is effective in teaching positive environmental attitudes and values when programs and methods designed specifically to accomplish those objectives are used.
- The relationship between environmental knowledge and positive environmental attitudes is unclear; therefore, teaching only for greater knowledge is insufficient for promoting positive affective growth.
- Positive environmental attitudes and values, once acquired, appear to be long lasting.
- The development of environmental attitudes and values should begin before kindergarten and be further developed as students progress through elementary, middle, and senior high school.
- The relationships between environmental attitudes and age, socioeconomic status, place of residence (geographical, urban or rural), and gender is conflicting and inconclusive.
- Outdoor education experiences are an effective way of improving environmental attitudes and values.
- Various types of teaching methods seem to be effective in improving environmental attitudes and values.
- The media are powerful sources for influencing environmental attitudes and values.

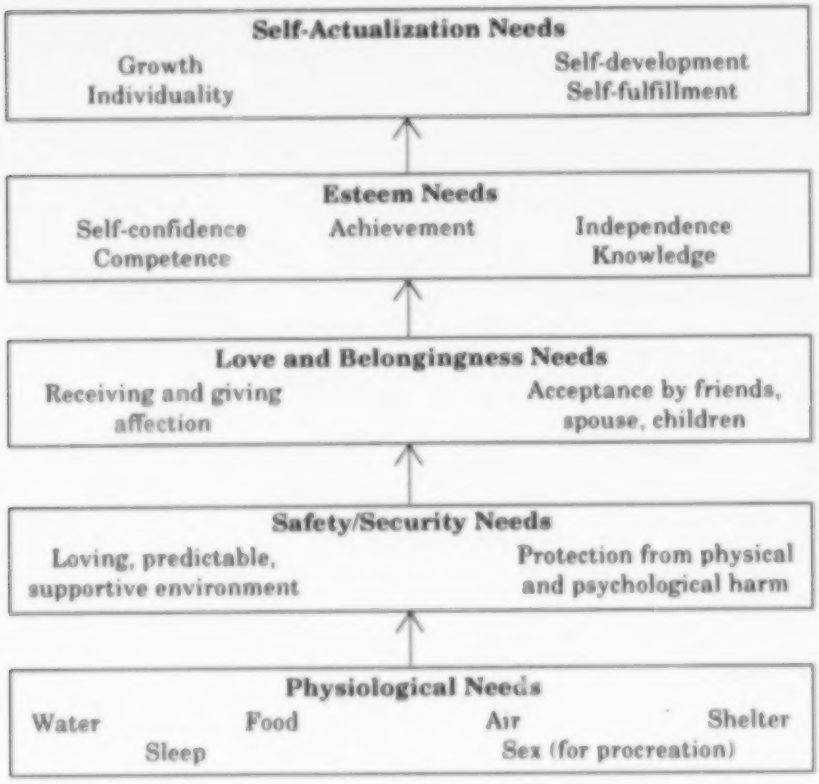
Figure 23

Stages in Value Formation in Children

Stage	*Characteristics*	*Major Sources of Influence*
One	• Social/environmental interactions limited • Value issues seen as good/bad, right/wrong, beautiful/ugly • Attitudes/values externally generated, based on emotional involvement • Values related to lower levels of hierarchy of fundamental needs (see Figure 24) • Many values inculcated • Reward/punishment important • Pre-adolescents emulate attitudes/values of people they admire	• Home/parents • Child care facilities/leaders • Schools/teachers • Respected/admired friends, fictional heroes, relatives
Two	• Societal/environmental interactions increase, less adult dependence, child influenced by increasing number of perceptions/ideas • Child realizes others have feelings/sensitivities, personal feelings associated with sense of self-worth • Values related to middle levels of hierarchy of fundamental needs (see Figure 24) • Child realizes value-laden issues are not black/white, realizes personal actions affect others, develops empathy for others	• Home/parents/siblings • School/teachers • Neighborhood • Media • Religious leaders
Three	• Child becomes aware of need for group decision making, rules of behavior, economic considerations in satisfying wants and needs of self and others • Child recognizes value-laden issues have alternative viewpoints, may consider each equally acceptable/reasonable • Decision making viewed as applying rules of larger community determining new rules by majority vote or dictates of chosen superiors/leaders; comfort found in rules of group to which there is established allegiance • Value-laden issues viewed as having alternative solutions each with pros/cons, personal decisions often abandoned to comply with group decisions • Some individuals may establish strong allegiance to group, accept its attitudes/values and label (for example, radical, intellectual, conservative, environmentalist)	• Home/parents/siblings • School/teachers • Religious leaders • Media • Primary allegiance groups
Four	• Child begins to use critical reflection and judgment to determine what is desirable, going beyond needs and wants of self and/or primary allegiance group • Increased ability to reason leads to greater social/environmental harmony, greater use of group consensus • At maximum stage of development, child seeks universal consensus and harmony in the resolution of global issues	• Formal educational, religious, social organizations • Scholars • Philosophers • Media
Five	• Individual realizes fallibility of human reason and possibility of error even in careful, rational decisions • Concern is for pursuit of ideal, discovery of ultimate, universal principles for determining good/bad, and so forth • Great concern for process of decision making aimed at achieving ideal resolution of issues so as to achieve utopian levels of harmony among individuals and the environment they share	• Formal education • Social institutions, especially religious organizations

Figure 24

Hierarchy of Fundamental Needs



Applying Research Results

As previously stated, the results of recent educational research provide a basis for structuring environmental education curricula and programs. A discussion of the implications of this research at four levels—grades K-3, 3-6, 6-9, and 9-12 follows.

Grades K-3

Up to an age of seven or eight, or about grade 3, most children are passing through Piaget's preoperational stage of intellectual development (Figure 12, page 53). Their principal access to the environment is through direct sensory perception. At this level a planned program of observational experiences involving touching, seeing, hearing, smelling, and tasting would help children develop process skills basic to exploring and understanding the environment. Developing observational skills

takes considerable time, perhaps as long as two years, and must not be rushed. In the later stages of such a program, skill in observing may be applied to develop other process skills such as classifying, sequencing, and understanding spatial relationships, and later still, measuring and quantifying, inferring, predicting, analyzing, and interpreting.

Further supporting the desirability of such a program is research showing that a large amount of the brain growth during this period (Figure 13, page 55) is in the attentional system, with an increase in perceptive abilities, and the sensory system (Figure 19, page 65), with an increasing rate of development of left/right brain functions. Support also comes from the research showing that a major factor in developing environmental sensitivity (Figure 18, page 63) is direct experience within natural environments.

In light of this research, the perceptual awareness subgoal should receive major emphasis in grades K-3.

As indicated in section 3, the process skills developed at this level are critical to the construction of knowledge, which begins with the observation of objects and/or events. In order to maximize the efficiency of knowledge construction, there first should be a major emphasis on developing the process skills of the perceptual awareness subgoal, with a lower emphasis on the knowledge subgoal. However, instructional activities planned to develop process skills also help to develop knowledge. For example, if an activity to develop observational skills involves children examining trees, they also will begin to construct knowledge about trees. Initially, in grades K-1, this knowledge probably will be at level 1.00 Knowledge, but later, in grades 2 to 3, it will be at level 2.00 Comprehensive (Figure 14, page 57). The emphasis on developing process skills should exceed that on the acquisition of knowledge until grade 3, at which time they should become approximately equal.

In terms of moral development, most children in grades K-3 are in Piaget's egocentric stage (Figure 15, page 58), are just entering Kohlberg's first stage of punishment-obedience (Figure 15, page 58), and are in stage one of value formation (Figure 23, page 70). The environmental ethic subgoal should receive major emphasis in grades K-3, emphasizing outcomes as described in the discussion of this subgoal in section 3, and more specifically, the type of outcomes suggested under levels 1.0 Receiving, 2.0 Responding, and to a lesser degree, 3.0 Valuing, of the Taxonomy of Educational Objectives: Affective Domain (Figure 9, pages 39-40).

As indicated in the discussion of the subgoals of citizen action skills and citizen action experience in section 3, the emphasis at the K-3 level should be on acquiring a set of generic learning skills that serve as a basis for later development of true citizen action skills. True citizen action skills are related closely to the upper levels of the Taxonomy of Educational Objectives: Cognitive Domain (Figure 11, pages 45-46), levels that are less appropriate for major attention at these grade levels.

In summary, subgoal emphasis in grades K-3 should receive the following emphasis.

Major emphasis: Perceptual awareness and environmental ethic.

Minor emphasis: Knowledge, citizen action skills, and citizen action experience.

Grades 3-6

By third grade, children ages 8 to 9 should have developed the process skills that facilitate the construction of knowledge. Most are now in Piaget's concrete operational stage (Figure 12, page 53) and many are able to deal with objectives at levels 2.00 Comprehension and 3.00 Application, in the Taxonomy of Educational Objectives: Cognitive Domain (Figure 11, pages 45-46). As the sensory system of the brain (Figure 19, page 65) continues to develop, these children are able to perform elementary logical operations and become better at perceiving the kinds of information listed in Figure 20, page 66. Each student develops a personal best learning style (Figures 21 and 22, pages 67-68) and curriculum planners and teachers must attend to this by providing a variety of learning experiences so that every student has opportunities for efficient learning. The knowledge subgoal should receive major emphasis in grades 3-6.

The process skills of the perceptual awareness subgoal are utilized as students learn to construct higher and higher levels of knowledge. If these skills are adequately developed in grades K-3, fewer teaching activities need to concentrate on their development in grades 3-6. However, some instruction may be needed on higher-level process skills such as inferring, predicting, analyzing, and interpreting. But the overall emphasis on this subgoal is minor at these grade levels.

Early in this time period, students have not yet developed a personal environmental ethic. They have entered stage two of value formation (Figure 23, page 70), and most are functioning at level 3.0 Valuing, of the Taxonomy of Educational Objectives: Affective Domain (Figure 9, pages 39-40). By the end of the period, some students are beginning to develop a personal environmental ethic. Some are at stage three of value formation (Figure 23, page 70), and some are beginning to function at level 4.0 Organization, of the Taxonomy of Educational Objectives: Affective Domain (Figure 9, pages 39-40). The environmental ethic subgoal should receive a major emphasis at this level.

As indicated in the discussion of the subgoals of citizen action skills and citizen action experience in section 3, there is also a set of generic learning skills to be emphasized at this level. These skills constitute the basis for the development of true citizen action skills. However, by the end of this period many students are able to operate as well at levels 2.00 Comprehension and 3.00 Application, of the Taxonomy of Educational Objectives: Cognitive Domain (Figure 14, page 57). Therefore, it would be appropriate to begin involving students at this level in activities that introduce true citizen action skills and provide citizen action experience.

In summary, subgoal emphasis in grades 3-6 should receive the following emphasis.

Major emphasis: Knowledge and environmental ethic.

Minor emphasis: Perceptual awareness, citizen action skills, and citizen action experience.

Grades 6-9

Children in these grades are usually from 11 to 15 years old. The brain continues to grow during this period, with most of the development taking place in the sensory system. Toward the end of the period, growth in the intentional system also takes place (Figure 19, page 65). Most students in these grades have passed or are passing into Piaget's formal operational stage (Figure 12, page 53) and are developing the ability of abstract thought.

The transition from childhood to adolescence is a crucial phase of life and deserves a distinctive educational program. —Paul DeHart Hurd

They are capable of working with objectives at level 3.00 Application, and later, levels 4.00 Analysis and 5.00 Synthesis of the Taxonomy of Educational Objectives: Cognitive Domain (Figure 14, page 57). Each has a definite preferred learning style that the teacher must recognize if each student is to be able to efficiently construct knowledge. The construction of knowledge is now of major importance because an understanding of ecological principles and issues contributes to positive environmental behavior (Figure 18, page 63).

Brain growth, especially that of the intentional system's increasing ability to formulate plans of action, has major implications for the subgoals of citizen action skills and citizen action experience. Many of the intellectual abilities and skills that constitute the higher levels of the Taxonomy of Educational Objectives: Cognitive Domain (Figure 11, pages 45-46) are related to this subgoal; therefore, it should be emphasized at this level.

Students who have reached this level are still developing a personal environmental ethic. They are in stage three of value formation, passing into stage four (Figure 23, page 70). In terms of the Taxonomy of Educational Objectives: Affective Domain, most students at this age are able to deal with levels 3.0 Valuing and 4.0 Organization, while some may even begin dealing with level 5.0 Characterization by a Value or Value Complex. This is the level at which females and males tend to diverge in their moral development, males following the development described by Kohlberg, females that described by Gilligan, changes that must be given special attention. The environmental ethic subgoal continues to be of major importance at this level.

The emphasis on the perceptual awareness subgoal is low at this level. Theoretically, most students have become proficient in its associated process skills and need little further direct instruction dealing with them. And since achieving the citizen action experience subgoal depends on a thorough development of citizen action skills, major emphasis on citizen action experience is not desirable at this time.

In summary, subgoal emphasis in grades 6-9 should receive the following emphasis.

Major emphasis: Knowledge, citizen action skills, and environmental ethic.

Minor emphasis: Perceptual awareness and citizen action experience.

Grades 9-12

Brain growth at this age level, 15 and older, Arlin's 5th Piagetian stage (Figures 12 and 13, pages 53 and 55), is particularly noticeable in the intentional system (Figure 19, page 65). The functions of this system are closely related to the intellectual abilities and skills that make up the three highest levels, 4.00 Analysis, 5.00 Synthesis, and 6.00 Evaluation, of the Taxonomy of Educational Objectives: Cognitive Domain (Figure 11, pages 45-46), which are the substance of the subgoals of citizen action skills and citizen action experience. And since environmental behavior research identifies knowledge of and skill in using environmental action strategies as a major empowerment variable leading to positive environmental behavior (Figure 18, page 63), these subgoals should receive major emphasis at this level.

Environmental behavior research also indicates that an in-depth knowledge about issues affects environmental behavior to only a minor extent, even though it is a major ownership variable. The knowledge essential to citizen action on environmental issues depends on the specific issue being attended to, thus instructional planning may not be able to predetermine what knowledge should be taught at this level, and a time allocation is therefore difficult to make. For this reason, the knowledge subgoal is designated for minor emphasis at this level although the knowledge needed to understand a particular issue is very important.

Most students at this level are well into stage four of value formation (Figure 23, page 70), and some are into stage five. Most are able to deal with objectives related to levels 3.0 Valuing and 4.0 Organization, and some are beginning to do so at level 5.0 Characterization by a Value or Value Complex (Figure 9, pages 39-40). Because of these characteristics, the environmental ethic subgoal should receive major emphasis at this level, as it has at the other three levels.

The emphasis on the perceptual awareness subgoal reaches its low point at this level, and only a small amount of time needs to be committed to this subgoal, usually to teach some special skill needed to construct needed knowledge or some citizen action skill.

In summary, subgoal emphasis in grades 9-12 should receive the following emphasis.

Major emphasis: Citizen action skills, citizen action experience, and environmental ethic.

Minor emphasis: Perceptual awareness and knowledge.

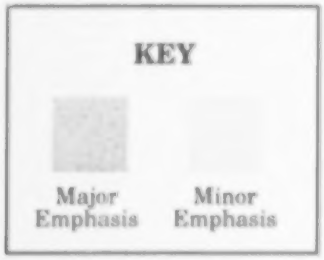
Models

The preceding discussion of the implications of educational research can be summarized using models. One such model appears in Figure 25.

Figure 26 is another model, but it does not portray the relative emphases on the subgoals. It portrays the relationships between the

Figure 25

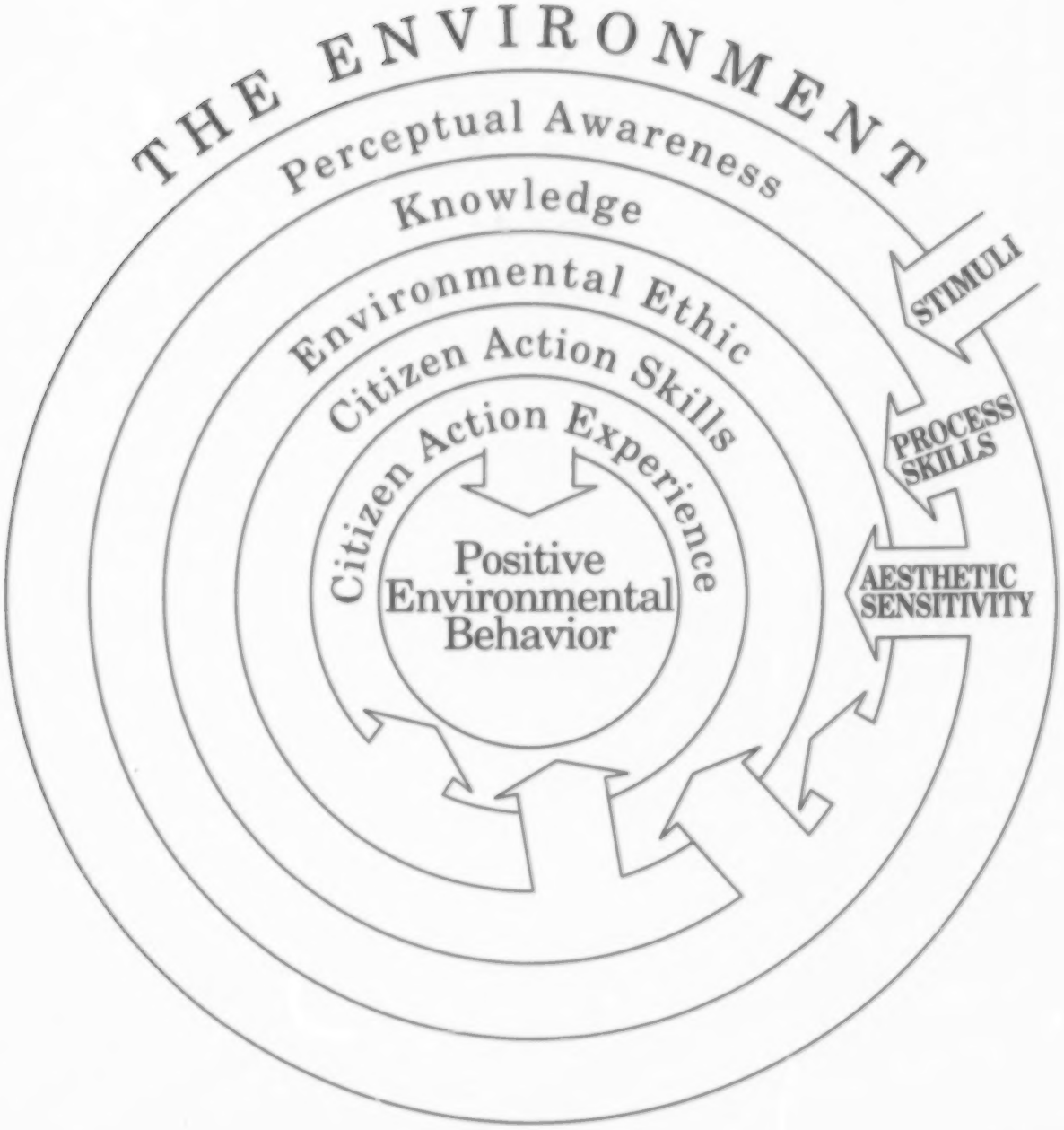
Wisconsin Curriculum Model for Environmental Education



SUBGOALS	GRADE LEVELS												
	K	1	2	3	4	5	6	7	8	9	10	11	12
Perceptual Awareness													
Knowledge													
Environmental Ethic													
Citizen Action Skills													
Citizen Action Experience													

Figure 26

Teaching for Positive Environmental Behavior



The research is very clear on the matter. Citizenship behavior can be developed through environmental education. The tools are available. The challenge lies in a willingness to do things differently than we have in the past.
—Harold R. Hungerford and Trudi L. Volk

subgoals and how they contribute to effecting positive environmental behavior. These relationships may be summarized as follows:

- Students develop perceptual awareness, the ability to efficiently perceive and process stimuli from the environment, which consists of a set of process skills and an aesthetic sensitivity.
- The process skills that constitute the basis of a perceptual awareness are used by students to construct knowledge.
- The aesthetic sensitivity developed by students as part of a perceptual awareness contributes to the development of a positive environmental ethic.
- The knowledge students construct contributes to the development of a positive environmental ethic.
- The knowledge students construct and the conceptual awareness resulting from the construction of that knowledge are utilized in developing a positive environmental ethic in developing citizen action skills and in gaining citizen action experience.
- The positive environmental ethic the students have developed, in conjunction with acquired citizen action skills and citizen action experience, result in positive environmental behavior.

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5

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The term curriculum as used in this section means a delineation of the content students are to learn and when the elements of that content are best learned. Instruction, the teacher-planned activities through which students learn this content, is discussed in section 6.

The major elements of the content of environmental education were presented in section 3. The time when each of those major elements is best learned was discussed in section 4. Figure 25 (page 76) graphically portrays this information. In addition, Figure 26 (page 77) portrays how each subgoal interacts with and contributes to the other subgoals.

The subgoals discussed in section 3 do not constitute a curriculum nor do the models of section 4, but the models suggest a skeleton, the major headings for a curriculum plan. It is the responsibility of the school district's environmental education committee, working with specific subject area committees, to complete the details of the plan—the actual objectives or learner outcomes to be attained through instruction.

What formal education has to do is to produce people who are fit to be inhabitants of the planet . . . . Otherwise [young people] are going to grow up and discover that we have taught them how to live in a world long gone.
—Kenneth Boulding

Members of these committees must take care not to commit the all-too-frequent mistake of developing curricula based only on knowledge objectives. Objectives dealing with perceptual awareness, an environmental ethic, citizen action skills, and citizen action experience are not knowledge-based and must also be included. These objectives should be expressed in the terminology of each subgoal. Students cannot effectively construct knowledge unless they develop the process skills of the perceptual awareness subgoal, and although these skills are learned using elements of knowledge as a vehicle, objectives for this subgoal must be phrased in terms of these process skills. Likewise, objectives for the development of citizen action skills should be phrased in the terminology of that subgoal. The same is true of objective statements for citizen action experience and for environmental ethic.

The Contributions of Subject Areas

All subject areas share the responsibility for developing and implementing objectives for each of the subgoals. This part of section 5 describes what might be expected of each subject area. The curriculum planner must realize that a K-12 program in environmental education consists of elements of virtually every subject area, some making a significant contribution, others a smaller but still very important contribution. In other words, elements of environmental education usually will not need to be "infused" into subject area curricula because they are currently there. But they will need to be identified and appropriately emphasized in subject area curriculum plans. Achieving the subgoals of environmental education is fully supportive of achieving existing subject area goals and objectives. The two are not in conflict, and additional instructional time should not be required in achieving them.

It may be necessary and desirable, however, for curriculum planners and teachers in some subject areas (for example, communication arts) to adopt new methodologies that allow for the achievement of both kinds of

goals and objectives. Examples of such situations are given in the following material.

Agriculture Education

The curriculum model appearing in *A Guide to Curriculum Planning in Agriculture Education* (DPI, 1988) is structured in three levels. At the elementary level (grades K-6), the recommended emphasis is on developing an awareness of agriculture and agribusiness and the role they play in the lives of people. Agriculture is generally not taught as a separate subject at the elementary level, it is usually incorporated into social studies or occasionally science education. The desired awareness of the role of agriculture should develop as programs in these subjects implement instruction in the fundamental principles listed in Figure 5, pages 27-31.

At the middle school level (grades 7-9), the model recommends an exploration of the food and fiber industry as part of a general vocational orientation class. The environmental emphasis in such a class also should be on the principles of Figure 5 and on issues selected to help develop citizen action skills.

The environmental emphasis at the secondary level (grades 9-12) should be rather prominent. The model recommends an emphasis on preparation for careers in agriculture and agribusiness, thus the development of an understanding of the potential environmental impacts of agriculture and agribusiness activities is very important. Not only is it important to include the study of the principles in Figure 5 in courses at this level, activities to develop citizen action skills and to provide citizen action experience also are vital.

A companion publication to the agriculture planning guide, *Instruction for Food and Fiber and Natural Resources* (DPI, 1989), recommends several courses in which this could be accomplished. They include: big game management in Wisconsin, conservation and soils, energy alternatives, energy conservation, environmental conservation, fish and fish management, forest science, ground water quality and management, natural resources, pollution, and soil science. Some of the issues listed for consideration in these units are: hunting, pesticides, nonpoint source pollution, alternative energy sources, energy use in agriculture, multiple use of forests, conservation versus preservation, asbestos, and wetland drainage. Sustainable agriculture also may be included.

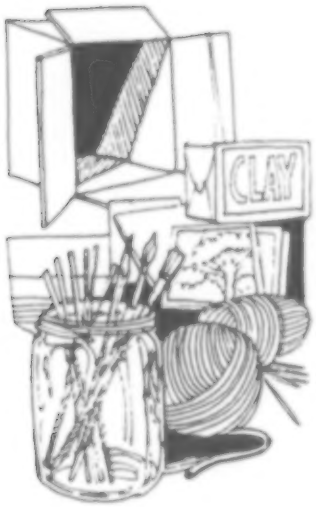
Many of these topics may be recognized as issues involving science, technology, and society. Agriculture education programs provide many excellent opportunities for teaching these kinds of issues, which are discussed in detail as part of the role of the sciences in environmental education.

Instruction in agriculture and agribusiness at any level also provides an opportunity to make a significant contribution to the development of a universal environmental ethic. Agriculture education curriculum planners should be sure to include objectives of this type in plans they develop.

Environmental degradation in all its forms is everybody's business; its control will require a massive mobilization of public, administrative, and scientific concern.
—Rene J. DuBos

Art Education

Beauty never stands alone. It is part of horizons, of blue in the distance, of morning dew glimmering on a fragile web.
—Sigurd Olson



Art education is primarily concerned with aesthetic experience—the perception and understanding of beauty. The philosophy of environmental education in section 2 states: ". . . education must consider all aspects of the environment—natural, built, technological, and social (economic, political, cultural, ethical, and aesthetic)—and acknowledge their interdependence . . . ."

Therefore, the importance of art education to environmental education is quite clear. Art education's concern for aesthetics and the development of perceptual awareness are closely related. As discussed in section 3, the perceptual awareness subgoal focuses on helping students develop certain process skills that enable them to perceive and discriminate among stimuli; to process, refine, and extend those perceptions; and to concurrently acquire an aesthetic sensitivity to both natural and built environments. This relationship becomes especially clear if the discussion of aesthetics and art processes in *A Guide to Curriculum Planning in Art Education* (DPI, 1985) is examined. The guide emphasizes the importance of knowing the elements and principles of design. Core design elements include texture, color, line, shape, and space. Figure 27 identifies the components of each of these core design elements to be developed in grades K-3. Core design principles are balance, contrast, rhythm, movement, and repetition. Figure 28 identifies the components of these core design principles to be developed in grades K-3. Figures 27, 28, and 29 are adapted from DPI's art curriculum guide.

Figure 27

Core Design Elements: Components for Grades K-3

Element	*Components*
Texture	Seeing, touching, identification, exploration, naming, environmental awareness
Color	Identification, discrimination, intensity, color families, environmental awareness
Line	Exploration, discrimination, directionality, naming, environmental awareness
Shape	Discrimination, naming, figure-ground perception, dimensionality, geometry, environmental awareness
Space	Figure-ground relationships, overlapping, position, movement, environmental awareness

Figure 28

Core Design Principles: Components for Grades K-3

Principle	*Components*
Balance	Visual, physical, arrangement, organization, mirror image, radial symmetry, environmental awareness
Contrast	Similarities, differences, opposites, visual discrimination (figure-ground, shape, distinction), environmental awareness
Rhythm	Beat, repetition, patterns, environmental awareness
Movement	Visual, physical, control, spatial, environmental awareness
Repetition	Patterns, organization, arrangement, elemental, environmental awareness

Relationships between the core design elements and principles and perceptual awareness should be apparent. In order to learn these elements and principles, students must be involved in the kinds of activities required for the development of perceptual awareness. The potential contribution of art education to the development of observational skills should be particularly apparent. Students use their senses of sight and touch in observing colors and textures. In teaching the elements of line, shape, and space, an understanding of spatial relationships should develop. In teaching the principle of contrast, activities on observing similarities and differences become the beginning of understanding classification schemes. Similar statements could be made regarding relationships between other design elements and principles and perceptual awareness.

Art education also has a potential role in promoting other subgoals of environmental education. The DPI's art curriculum planning guide identifies five generalizations that provide structure to a K-12 conceptual framework for art education. The guide addresses each generalization in terms of three categories: art and the individual, art and society, and art and the environment. Figure 29 lists these generalizations and related concepts to illustrate how art and the environment might be addressed. (The art guide includes an additional 30 concepts on art and the environment.)

I would suggest that the teacher should not concentrate on teaching the child to paint or print, but to see; to help the development of the child's visual language both in understanding and expression, and to relate that language to [the] everyday world, and thus promote hopefully—a greater awareness, understanding, and concern for environment.
—Eileen Adams

Figure 29

Art Education Generalizations and Mental Concepts

Generalization	*Concept*
Aesthetics: Involvement in art develops aesthetic awareness, which can improve the quality of life.	Art can reflect the order and aesthetic qualities of structural systems found in nature.
Change: Change is an inherent certainty of life and affects all dimensions of human existence.	An environment can be transformed aesthetically to reflect the interests and values of its inhabitants.
Communication: Communication involves expression and perception of feelings, ideas, and information necessary for human interaction and understanding.	Art may communicate the order found in nature.
Human Wholeness: Human wholeness and potential are nurtured through expressive, sensory, intellectual, and social experience.	The process of creating an aesthetic environment fulfills one's emotional and sensory needs.
Interdependency: The quality of human life is affected by environmental and cultural interdependencies.	The terrain and materials indigenous to an area can influence the design of architectural structures.

In this environment-oriented approach, art instruction in the schools will explore many diverse areas, among them: the unique and universal qualities of the individual; the functional and aesthetic arrangement of surroundings; mass communication and media and social comment; neighborhood improvement and town planning; the [human]-nature relationship and the challenges of ecology.
—Arnel W. Pattemore

The following list of typical environmental learner outcomes suggests that art education has a major role to play in the development of a positive environmental ethic and in the development of citizen action skills. The role of art in the resolution of environmental issues and problems also should be apparent.

Students will

- recognize the relative quality of their immediate environment and other environments beyond it.
- recognize that human sensitivity to, and appreciation of, environmental quality can be enhanced through the practice of various art forms.
- compare and contrast the humanizing and dehumanizing effects of environments constructed by people.
- develop a sense that they affect, are affected by, and have a responsibility for the environment.

- explain how art contributes directly to aesthetic awareness of, and sensitivity to, natural and built environments.
- make environmental decisions based on aesthetic concepts developed in art.
- recognize that art reflects the artist's experiences, culture, and environments.
- realize their responsibility to positively affect the environment by influencing others to utilize appropriate design.
- evaluate a debate contrasting socioeconomic interests with aesthetic considerations.
- cite reasons why land-use planning must include aesthetic considerations.
- demonstrate skill in using creative expressions as a means of bringing about constructive action to resolve social and environmental issues.

Business Education

The curriculum model in *A Curriculum Planning Guide in Business Education* (DPI, 1987) recommends numerous courses that may help achieve the subgoals of environmental education. A discussion of these courses follows. The course title, grade level, length, and potential contribution are provided for each.

- American enterprise, grade 7, nine weeks/semester: This course includes a study of the evolution of the American economic system. It presents an opportunity to incorporate teaching about the relationship of economics to the environment in terms of the knowledge subgoal category of fundamental principles dealing with humans as ecosystem components, especially the impacts of technology on the environment and the need to reduce, recycle, and reuse material goods.
- Business concepts, grade 9, semester: This course is similar in content to American enterprise so the suggestions made for that course also apply to this one. One of the competencies identified for this course is: "Understand the interdependence of business among nations." Teaching for this competency provides an opportunity to emphasize global aspects of the environment and environmental issues.
- Business economics, grade 11, semester: The suggestions made for American enterprise also apply to this course but even more so. Four of the competencies identified for achievement in this course relate to environmental education.
  - "Understand the necessity for choices and the role of the decision-making process for analyzing individual, business, and social wants and priorities."
  - "Comprehend basic business and economic concepts."
  - "Apply economic concepts to consumer decision-making, buying, saving, and investing."
  - "Demonstrate an understanding of current local, state, national, and international economic issues."

The consideration of the environmental impacts of choices and decisions should be an important part of teaching for the first competency.

Treat the Earth well.
It was not given to
you by your parents.
It was loaned to you
by your children.
—Kenyan proverb

The close relationships between economic and ecological systems should be an important part of teaching for the second and fourth competencies. Environmental considerations in consumerism—excess packaging, recyclability, and so forth—are important ideas to include in teaching for the third competency.

- Personal finance and consumer education, grade 11, semester: Four of the competencies identified for achievement in this course relate to environmental education.

— "Distinguish between consumer needs and wants."
— "Identify and describe the implications of major consumer protection laws and governmental consumer policies."
— "Describe positive and negative effects of marketing on consumer choice."
— "Identify groups and agencies that assist consumers."

In teaching for each of these competencies, the need to consider the environmental impacts of consumer decisions is of critical importance. Consumer education instruction provides numerous opportunities to help students progress in the development of a personal environmental ethic.

Communication Arts

What was referred to as language arts in the past is now called communication arts, a label that emphasizes function rather than medium used. *A Guide to Curriculum Planning in English Language Arts* (DPI, 1986) defines communication arts as listening, speaking (including drama), writing, and reading. Speaking and reading are often taught separately from the others, but the current trend is to combine instruction in all communication arts in order to focus on their function—communicating. Another important new aspect of curriculum and instruction in communication arts is the inclusion of mass communication media—film, television, radio, and computer networks. Communication media are dealt with both as an object of study and as a tool of communication.

There are several purposes for communicating.

Expressing. The sender communicates in order to clarify his or her feelings. Examples include: journals; diaries; conversations; manifestos; and resolutions.

Ritualizing. The communication is an attempt to comply with a convention and focuses on the cultural/situational context of the message. Examples include: greetings; farewells; special occasion speeches; conducting meetings; accepting or presenting awards; contracts; letters of appreciation, congratulations, or sympathy; resolutions; constitutions and bylaws; and invitations.

Transmitting Feeling. The communication is to provide aesthetic pleasure for both sender and receiver. It is language-centered, focusing on the discourse as a work of art using language as a medium. Examples

include: poetry; short stories; lyrics; narratives; drama; TV shows; movies; limericks and jokes; ballads; and folk songs.

Informing. The communication is subject-centered, exploring a question, providing information, or producing evidence for given questions. Examples include: diagnoses; news articles; reports; summaries; textbooks; or proposals for solutions to problems.

Persuading. The communication is receiver-centered and attempts to change thinking or attitudes. Examples include: advertising; political speeches; legal oratories; editorials; and letters to elected officials.

The contribution of the language arts to environmental education should be clear. Activities such as keeping a journal, drafting resolutions, writing constitutions and bylaws, expressing feelings through poetry or song, completing reports, and writing letters to elected officials are very important in the development of citizen action skills. The importance of teaching for competency in communicating in the elementary school was pointed out in the discussion of citizen action skills in section 3. The critical importance of being able to use secondary information sources—to develop skill in interviewing experts, using library/media reference systems, and recording notes—was explained in the discussion of citizen action skills at the middle/senior high school level also in section 3.

The teaching of literature as part of the communication arts also offers many opportunities to contribute to environmental education. The works of writers such as John Muir, Aldo Leopold, Henry David Thoreau, Rachel Carson, Mary Austin, Barry Commoner, Sally Carrighar, Garrett Hardin, Rene Dubos, Annie Dillard, Edward Abbey, Joseph Wood Krutch, Ann Zwinger, and many others might be selected to achieve specific communication arts objectives.

Drama, whether in the form of dramatic play, informal drama, or theater, is another aspect of communication arts with potential for contributing to environmental education. For example, classroom instruction might involve elementary children acting out scenarios depicting a use of water (for example, a wilted plant revived by providing it with water). Older students might act out *The Lorax* by Dr. Seuss. High school students might present a play such as Henrik Ibsen's *Enemy of the People*.

The principal contributions that communication arts makes to environmental education are in achieving the subgoals of perceptual awareness, environmental ethic, and citizen action skills. Many activities that are used with very young children to develop observation abilities contribute to an ability to discriminate visually, an important skill for emergent readers. Alphabet hikes or number hikes along streets in the school neighborhood are examples of activities that contribute to this end. Activities leading to skills in sequencing and classifying also contribute to the development of emergent and beginning readers.

Another example of an activity in which objectives for communication arts and environmental education are both achieved involves emergent

'Environmental literature' is presumed to be distinguished from other writing about the environment in possessing aesthetic qualities that make it worthy of consideration for its own sake. While we do not require of environmental literature that it raise moral or political issues, it might be said that, other things being equal, environmental literature that allows for raising of such issues is to be preferred for teaching purposes over that which does not.
—Walter H. Clark, Jr.

She had never seen such big wolves. The biggest one was taller than Laura. He was even taller than Mary. Everything about him was big—his pointed ears, and his pointed mouth with the tongue hanging out, and his strong shoulders and legs, and his two paws side by side, and his tail curled around the squatting haunch. His coat was shaggy and his eyes were glittering green.
—Laura Ingalls Wilder

or beginning readers who are still learning to write. They are asked to select an object in the environment that they find interesting, study it carefully with all senses except taste, and become a spokesperson for the object. For these students the activity is a speaking activity that concurrently helps to develop observational skills. A similar activity can be used with older students who are passing from the beginning reading to reading-for-consolidation stage of reading development and now can write. They are asked to select an object from the environment without identifying it to anyone else. While secretly observing the object, they list five to ten descriptive words on a small piece of paper. Other class members then attempt to identify the object from the descriptive clues. Such an activity concurrently achieves communication arts objectives related to vocabulary development and helps to polish observation skills.

Communication arts instruction also can contribute to the development of an environmental ethic. Upper elementary or middle school students might be asked to read a book (for example, *Little House on the Prairie*) and respond to a set of questions contrasting the environmental impact of its characters' lifestyle to that of their own. For example, they might be asked to compare what the characters might have put into a trash can, if they had one, to what they and their family put into their trash can.

At the middle and senior high school level, communication arts instruction can make a major contribution to developing citizen action skills. Also at this level, careful selection of literature, both fiction and nonfiction, can make a major contribution to forming attitudes and values.

Dance Education

The overview of *A Guide to Curriculum Planning in Dance* (DPI, 1988) begins with this statement: "Dance is a celebration of life, tradition, socialization, therapy, ethnic expression, worship, communication, a form of physical education, aesthetic experience, a fine art." Later in the overview, the following statements appear: "Dance universally expresses what cannot be put into words." and "Dance has been, is, and may always be one of the most effective means of passing on the culture of nations from one generation to another."

The guide also points out the educational value of dance. "Dance can improve physical and mental health, provide a means of self-expression, and offer a healthy way of socializing. It can also enhance understanding of a person's own culture and other cultures, increase cognitive skills, reinforce academic studies, and improve aesthetic skills and perceptual awareness."

Dancing is an excellent technique to help students process stimuli they receive from the environment, to internalize their experiences, and to develop a feeling of oneness with the environment. For example, students may observe how a leaf flutters as it falls, a twig floats on a stream or other water body, a tree moves in response to winds, a bird flies, a fish swims, rain falls, or water runs downhill, and then try to act out what they have observed.

Dancing is also an excellent technique to use in helping students gain an understanding of how an organism functions. Students can form the outline of a tree—its roots, trunk, branches, and leaves. Other students can portray water being "absorbed" by the roots from the soil and with it, minerals. This water-mineral "solution" could move up the trunk, through the branches, to the leaves. There it would interact with some students portraying carbon dioxide and other students portraying sunshine to create glucose, water, and molecular oxygen in the process of photosynthesis.

Asking students to do an interpretive dance of a musical composition such as Smetana's *Moldau* is another example. This composition is a particularly good one because each of its seven segments describes a different section of a river or activities along its banks, including its source as two small streams, their combining into a larger stream, a hunt and a dance along the river, the river from sunset through the night until the dawn, rapids on the river, and finally the river's joining with a much larger stream. Or students can observe a stream—its pools, rapids, meanders, quiet stretches, and so forth—and create a dance to express those observations.

From these examples, it should be apparent that dance can be a very useful medium for teaching about the environment, its primary contributions being toward attaining the subgoals of perceptual awareness and environmental ethic. But it also may serve as a means of portraying knowledge concepts and as a means of communicating concern about environmental issues and problems.

Family and Consumer Education

In the past, this curricular area was referred to as home economics. The current name more accurately describes the intended focus of this program. The structure for family and consumer education provided in *A Guide to Curriculum Planning in Home Economics* (DPI, 1987) describes a program that is exploratory in nature in grades 6-8 and consists of a set of component courses in grades 9-12. The exploratory course and several of the high school courses offer an opportunity to examine many different environmental issues, thus contributing to the achievement of the subgoals of knowledge, environmental ethic, and citizen action skills.

One suggested course, family and technology, explores the impact of technology on the family. Some environmental issues that might be explored in this course are energy use and conservation, excess packaging, solid waste disposal, recycling, chemical food additives, hazardous chemicals, and the impact of the automobile on the environment. In family, food, and society many of the same issues might be examined. In consumer economics the differences between needs and desires, and the ecological basis of economic systems may be explored.

Global Studies

Like environmental education, global studies is not usually considered a separate subject area. Although courses in both of these fields are

We live today in a globally interconnected world, in which biological, psychological, social, and environmental phenomena are all interdependent. To describe this world appropriately we need an ecological perspective.
—Fritjof Capra

sometimes offered at the secondary level, incorporation into the curriculum framework of common subject areas is more desirable and more frequently the practice.

There are other similarities between global studies and environmental education. Two of the four global studies perspectives identified in *A Guide to Curriculum Planning in Global Studies* (DPI, 1992) are global systems and global issues, both very basic to any environmental education curriculum. Also, one of the geographic themes that frames the global studies curriculum is human-environmental interactions. Four of the nine key questions and concepts for the study of global interdependence listed in this guide are: What are Earth's natural systems?; How do natural systems support and sustain each other?; How do changes in one natural system effect changes in other natural systems?; and What choices do humans make relative to changes in Earth's natural systems?

The guide's suggestions for incorporating global studies into curricula focus on social studies more than any other discipline. Many of the sample social studies activities include major environmental elements. For example, in Cotton, Cars, and Computers: Goods and Technology in a Global Economy, the environmental impacts of these items are considered. In All That Garbage, the production and disposal of waste are discussed. Too Many of Us deals with human population problems. Earth—Home or Space Station? focuses on tropical rainforests and other complex ecosystems. Each of these activities is also related to several other subject areas.

Many of the guide's suggestions for integrating global studies into other subject areas are similar to those made elsewhere in this section and make a strong contribution to the goals and subgoals of environmental education.

Health Education

Health education is one of the most important subject areas in which to deal with various aspects of the environment. Ten major content areas are identified in *A Guide to Curriculum Planning in Health Education*, and one of them is environmental health. Topics are suggested for study at each level, grades 3-6, the middle/junior high school, and senior high school. Figure 30, which is adapted from DPI's health education guide, presents these topics.

Figure 30

Environmental Health Topics

Grade Level	*Topics*
3	Litter reduction Maintaining health environments Kinds and sources of environmental pollution Air pollution problems
4	Individual and community responsibility for preventing environmental problems Providing safe water Sewage disposal Water conservation Environmental impacts on physical and mental health
5	Solid waste disposal Appreciating natural beauty Environmental impacts of increasing human populations
6	Environmental impacts on physical and mental health Predicting future environmental changes through 2000 Rats and insects and the environment Sanitation problems
Middle/ Junior High School	The impact of technology on the environment and human health Environmental health agencies Personal environmental responsibility Air, water, and land pollution Noise pollution Carcinogens in the environment Environmental effects of radiation Environmental health history
High School	Predicting future environmental changes through 2040 Analyzing the roles of environmental agencies and organizations Preserving a healthy school and community environment Pros and cons of various energy sources Potential environmental impacts of toxic waste disposal Historical improvements in air and water quality Individual and societal values and environmental health Environmental impacts of personal and family lifestyles Conflicting philosophies of regulating environmental quality

Several other health education content areas also touch upon environment. A study of the environmental health section of a community health department is suggested for grade 6 in the community health strand. How the environment affects one's feelings is a suggested topic for study in grade 2 in the mental/emotional health strand. A study of governmental health regulatory agencies is a suggested topic for study in senior high school in the consumer health strand.

These suggestions are easily related to various subgoals for environmental education. Most of the topics suggested for the elementary and middle/junior high school grades fit under the knowledge subgoal and are listed in Figure 5 (pages 27-31). Several of the topics for the middle/junior high school and the senior high school fit under the subgoals of citizen action skills and citizen action experience. Health education has great potential for contributing to the achievement of these subgoals. It can serve as a vehicle to develop needed skills while concurrently achieving appropriate health education objectives.

Marketing Education

Marketing education as described in *A Guide to Curriculum Planning in Marketing Education* (DPI, 1987) is based on three foundation areas: human resource foundations, economic foundations, and marketing and business foundations. Economic foundations is the area with the greatest potential for teaching about the environment. A contribution to environmental education can be made if the ecological basis for all economic systems and the potential environmental impacts of all business activities are discussed.

Mathematics Education

A K-12 mathematics curriculum as described in *A Guide to Curriculum Planning in Mathematics* (DPI, 1986) includes seven different strands. Five of these strands are important to environmental education because they include objectives closely related to the various subgoals. Figures 31 to 35 are originally from the DPI's mathematics curriculum guide and are adapted to show the strand's link to environmental education.

Measurement

One of the most frequently applied topics from mathematics is measurement. It is natural to have children study the environment by measuring. For example, measures associated with weather can be conducted at all grade levels. These include temperature, precipitation, humidity, and wind velocity. Measures of length, area, and volume can be applied to natural objects such as trees. Indirect measure can be used to find the diameter or height of a tree. Estimates can be made of the measures of water in a lake or the width of rivers. Figure 31 outlines illustrative examples of measurement objectives and related subgoals of environmental education.

Figure 31

Measurement Objectives Related to Environmental Education

Grade Level	*Measurement Objectives*	*Subgoal / Component*
K-3	Organize techniques related to measuring, using selected arbitrary units of measure.	Perceptual awareness: measuring and quantifying
	Become familiar with attributes of length, weight, area, liquid capacity, time, temperature, and monetary value.	Perceptual awareness: measuring and quantifying
	Acquire the skills associated with length measurement, including exposure to the following units: inch, foot, yard, meter, centimeter; a knowledge of the relative size of one unit to another; an ability to read and write the requisite vocabulary words associated with them; and a familiarity with the abbreviations and symbols. These skills include the ability to use a standard measuring instrument calibrated in one or more of these units and to read a measurement to the nearest half-inch or centimeter.	Perceptual awareness: measuring and quantifying
4-6	Understand the nature of the measurement process, including K-3 objectives and new notions such as precision, estimation, direct and indirect measurement.	Perceptual awareness: measuring and quantifying
7-8	Understand the indirect measurement process involved in such procedures as the use of formulas, similar triangles, scale drawings, the Pythagorean theorem, and simple right triangle trigonometry.	Perceptual awareness: measuring and quantifying
9-12	Acquire the ability to use measuring devices related to scientific inquiry in subjects such as earth science, environmental science, biology, chemistry, physics, home economics, agriculture, and industrial arts.	Perceptual awareness: measuring and quantifying Citizen action skills: using primary sources of information

Geometry

Objects in nature can be described according to the degree to which they approximate geometric shapes. Measurement properties of geometric shapes may be used to estimate the measure of objects in nature. For example, a geologic kettle may resemble a hemisphere, so knowledge of properties of hemispheres may be applied to the description of these depressions. The concept of slope may be applied to descriptions of surfaces, and techniques for determining the slope of a surface can be explored. The Pythagorean theorem has many applications in indirect measurement. Figure 32 outlines illustrative examples of geometry objectives and related subgoals of environmental education for grades K-6.

Arithmetic and Algebra

Arithmetic and algebra can be used in quantitative studies of the environment. The erosion caused by a stream can be estimated in inches per year, and that estimate can be used to project the amount of soil lost in five years, 50 years, or 500 years. The amount of energy production necessary for a community can be calculated based on a historically determined average rate of consumption per person. Figure 33 outlines illustrative examples of arithmetic and algebra objectives and related subgoals of environmental education for grades K-6.

Statistics

Statistical procedures are frequently used in studies of the environment. Wild animal populations and migrations may be studied by tagging a sample from a population and then doing subsequent studies in which representatives from the sample are rediscovered. Statistical studies are often used to identify endangered species before that species becomes extinct. Statistical studies also can be used to project population growth and estimate the capacity of an environment to support a population of a particular size. Graphs are used to communicate statistical information about the environment. Figure 34 outlines illustrative examples of statistics objectives and related subgoals of environmental education.

Figure 32

Geometry Objectives Related to Environmental Education

Grade Level	*Geometry Objectives*	*Subgoal / Component*
K-3	Explore familiar two- and three-dimensional objects including properties such as inside, outside, flat, curved, straight, round, square, large, and small.	Perceptual awareness: observing understanding spatial relationships
	Identify and classify the following figures through visual observation and identified properties: triangles, squares, cubes, spheres, circles, open and closed curves.	Perceptual awareness: observing understanding spatial relationships
	Explore simple patterns of symmetry in the environment.	Perceptual awareness: observing
	Become familiar with the attribute of length by using either arbitrary or standard units; students experience the direct measurement of this attribute.	Perceptual awareness: measuring and quantifying
4-6	Identify and classify the following figures and their parts: rectangular prism, cylinder, cone, pyramid, parallelogram, quadrilateral, isosceles triangle, angle (right, acute, obtuse), circle, rectangle, rhombus, square, and trapezoid.	Perceptual awareness: observing understanding spatial relationships

Figure 33

Arithmetic and Algebra Objectives Related to Environmental Education

Grade Level	*Arithmetic and Algebra Objectives*	*Subgoal / Component*
K-3	Identify the number of objects in a set by counting or by estimating. Decide which is appropriate.	Perceptual awareness: observation measuring and quantifying
	Use objects, pictures, and problem situations to model and interpret different definitions of addition, subtraction, multiplication, and division of whole numbers.	Perceptual awareness: measuring and quantifying
	Compare the number of objects in large sets.	Perceptual awareness: measuring and quantifying
	Develop pattern recognition by working with simple sequences that are determined by numerical or geometric properties or other attributes such as color or orientation.	Perceptual awareness: observing sequencing
4-6	Estimate the number of objects in large sets, deciding on needed level of accuracy for particular situations.	Perceptual awareness: measuring and quantifying

Figure 34

Statistics Objectives Related to Environmental Education

Grade Level	*Statistics Objectives*	*Subgoal / Component*
K-3	Gather data by counting, by performing simple experiments, by measuring, or from various media sources such as newspapers, magazines, almanacs.	Perceptual awareness: measuring and quantifying Citizen action skills
	Organize a set of data by tallying and ordering.	Perceptual awareness: interpreting Citizen action skills
	Construct bar graphs, histograms, and pictograms based on data from realistic classroom problem situations. State impressions obtained from these graphs.	Perceptual awareness: inferring interpreting Citizen action skills
4-6	Gather data by conducting a survey or by carrying out a simulation.	Citizen action skills
	Construct simple line graphs and stem and leaf plots. State impressions obtained from such graphs.	Perceptual awareness: interpreting Citizen action skills
	Recognize that the quality of a set of data depends on the source of the set of data and on the gathering technique used.	Perceptual awareness: interpreting Citizen action skills
7-8	Identify trends or variations in the graphic representations of a given set of data.	Citizen action skills
	Construct a median fit line, and then use this line to make predictions and to fill in information missing from the graph.	Citizen action skills
9-12	Formulate appropriate questions for a given objective, and construct an experiment to meet that objective. This includes identifying a suitable population and deciding if a survey or census is appropriate.	Citizen action skills Citizen action experience
	Select appropriate graphing techniques to represent a set of data.	Citizen action skills Citizen action experience
	Express conclusions and interpretations in written form for a given representation of data, and clearly communicate the results.	Citizen action skills Citizen action experience

Discrete Mathematics

This is a new strand in the mathematics curriculum, much of which involves algorithmic thinking. Algorithms are step-by-step procedures to be followed in order to produce a desired result (for example, averaging a set of numbers). Figure 35 outlines examples of discrete mathematics objectives and related subgoals of environmental education for grades K-6.

Figure 35

Discrete Mathematics Objectives Related to Environmental Education

Grade Level	*Discrete Mathematics Objectives*	*Subgoal / Component*
K-3	Sort sets on the basis of one attribute.	Perceptual awareness: classifying
K-3 and 4-6	Sort sets on the basis of multiple attributes.	Perceptual awareness: classifying

The preceding is not intended to be a comprehensive list of the applications of mathematics to environmental education. Mathematics teachers are encouraged to use these and other applications both to motivate the study of each topic and to illustrate to students the usefulness of mathematics, concurrently contributing to their education about the environment.

Music Education

Music education's principal contribution to environmental education is in helping attain the subgoals of perceptual awareness and environmental ethic. However, music is a powerful means of communication. Therefore, it also might be utilized as a persuasion strategy to promote the development of a conceptual awareness of environmental issues or to change people's behavior, thus contributing to the attainment of the subgoals of citizen action skills and citizen action experience.

The structure of the music curriculum, as described in *A Guide to Curriculum Planning in Music* (DPI, 1986), includes seven elements: expression, melody, rhythm, harmony, timbre, texture, and form. These elements are taught in general music in grades K-8, choral music in grades 5-12, and instrumental music in grades 5-12.

General music provides numerous opportunities to use both natural and built environments to teach for certain music education outcomes and concurrently contribute to attaining environmental education objectives. For example, the calls and songs of birds might be used to teach children in grades K-2 to recognize differences in tempi, dynamics, and contour (for example, fast or slow, loud or soft, smooth or jagged). Although recorded calls are available, experiencing and recording them in a natural environment is an excellent way to stimulate and motivate

student learning. An activity such as this not only achieves music education objectives but those of environmental education as well, in this case the development of skill in observing by listening.

Another general music example, for grades 5-6, is the use of music like the last movement of the *Grand Canyon Suite* by Ferde Grofe to illustrate ways in which musical elements contribute to the expressive qualities of music. While listening to this music, students may be asked to visualize an animal's experience in a night-time thunderstorm in the Grand Canyon. In doing so, children develop positive attitudes and values regarding wild places like the Grand Canyon and the needs of wildlife living there.

A third general music example deals with the musical element timbre. Students in grades K-2 might recycle various materials in making musical instruments and use them to recognize differences in timbre. For environmental education, this activity becomes a positive environmental action that also develops attitudes and values regarding reuse of materials.

Notions of musical melody, rhythm, and harmony might be developed in grades K-4 general music by asking children to observe the movement of grasses and/or trees in the wind, a soaring hawk or gull, the flight patterns of other birds, or the movements of a twig or leaf floating on a stream, and to draw a line on a piece of paper to represent the variations in these movements. They could then create a dance from this line, moving faster or slower, jumping into the air, and so forth, and then translate these movements into their own music. Activities such as these contribute to the attainment of the perceptual awareness subgoal by developing observing skills and aesthetic sensitivity, as well as the subgoal of environmental ethic.

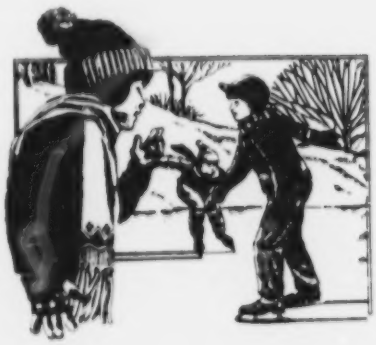
The expressive element of music can be studied by all children. The use of the *Grand Canyon Suite* by Ferde Grofe was previously described. There are many other works of all kinds of music—folk, country and western, rock, new age, and classical that describe some element of the environment or issues therein. The *Swan of Tuonela* by Sibelius describes in music how the majestic swan glides over the surface of the water. *Paradise* by John Prine expresses concern about strip mining of coal in Kentucky. *Common Ground* and other albums by Paul Winter are about rare or endangered species of animals, Earth itself, and other topics. Several of the recordings in *Common Ground* use the recorded calls of eagles, wolves, and whales as a starting point with instruments such as the oboe, soprano saxophone, and cello emulating them later in the composition. And recently, recordings of classical music composers (Beethoven, Chopin, Liszt, and so forth) combined with sounds of nature have been released.

The creation of music about the environment is another splendid activity for students of all ages. Young students can write environmental lyrics to be sung using well-known music (for example, *Jingle Bells*). Older students can actually compose instrumental music to convey their observations and feelings about the environment. Smetana's *Moldau* describes a river and the activities of humans along its banks. High

school students could easily visit a stream and create music to describe not only its pools, rapids, meanders, and slow-flowing sections, but the activities of humans and other living things found near the stream. In doing so they develop a sensitivity to such environments, a sensitivity that may lead to a greater concern when such environments are threatened.

Physical Education

The development of lifetime skills has become an important part of the physical education curriculum and is listed as a major program objective in *A Guide to Curriculum Planning in Physical Education* (DPI, 1985). Included in this emphasis are canoeing, backpacking, camping, fishing, hunter safety, cross-country skiing, rappelling, rock climbing, orienteering, and other activities. Physical education programs have become a means to deal with topics like outdoor ethics, the pros and cons of hunting, consumptive versus nonconsumptive outdoor activities, and the relationship of a quality environment to physical and mental health.



Science Education

According to *A Guide to Curriculum Planning in Science* (DPI, 1986), science education programs should include four components.

- problem solving: a sequence of four groups of actions— questioning, collecting data, analyzing data, and explaining—each consisting of several process skills.
- science knowledge: a framework organized around six conceptual schemes—diversity, change, continuity, interaction, organization, and limitation.
- nature of science: a study of the history and philosophy of science, and the actions and interactions of scientists.
- science, technology, and society: the study of the relationships among these three elements in terms of attitudes and beliefs, economics, politics, societal needs, and personal needs.

Environmental education is often mistakenly regarded as a specialized area of science education, perhaps because much of the knowledge listed in Figures 4 and 5 (pages 22-31) is drawn from science. Also, there is a strong tendency among the general public to consider the terms ecology and environment as being synonymous. Environmental education is an important part of each of the four components of science, but it is not in any sense equivalent to science education. Further discussion of the four components of science education and their relationship to the subgoals of environmental education should help clarify the confusion.

Problem Solving

Each of the four problem-solving action groups—questioning, collecting data, analyzing data, and explaining—consists of several specific

actions, each requiring special skills and understanding. These are detailed in Figure 36, which is reprinted from DPI's science guide.

The similarity between the specific actions in Figure 36 and the process skills discussed in the perceptual awareness section of section 3 should be apparent. Observing, classifying, measuring and quantifying, inferring, and interpreting are terms found in both section 3 and Figure 36. The development of problem-solving skills in science and awareness about the environment have many common elements.

It is also important to note the recommended grade-level emphasis on the development of problem-solving skills and perceptual awareness. Figure 25 (page 76) shows a major emphasis on the perceptual awareness subgoal in grades K-3. *A Guide to Curriculum Planning in Science* recommends that 60 percent of classroom time be devoted to developing problem-solving skills in grades K-2. Thus the problem-solving component of science education makes a major contribution to the achievement of the perceptual awareness subgoal, particularly if the skills involved are developed via direct experiences in a variety of both natural and built environments.

Science Knowledge

When the six conceptual schemes of science education and the knowledge subgoal are compared, they exhibit an amazing similarity. In Figure 37 the conceptual schemes of science knowledge are listed and defined. Following each definition are references to specific sections of Figures 4 and 5 (pages 22-31).

Nature of Science

Investigations of environmental issues proceed in much the same way as do scientific investigations. Understanding the nature of science is the basis for personal evaluation of information that may be presented as scientific, and since information presented in trying to resolve environmental issues is often labeled as scientific, it is important that students gain an understanding of the nature of science. In that sense, understanding the nature of science is critical to environmental education.

Science, Technology, Society

During the second half of the twentieth century, science and technology have gained a greater influence over the daily lives of most individuals. The ability to make responsible decisions on science- and technology-related societal issues and to take action toward their resolution have become necessary to effective citizenship. Science, technology, society (STS) instruction occupies the interfaces among science, social studies, and technology education. Educators from these three disciplines must work together to identify areas of responsibility and to plan and implement instruction to achieve the goals and objectives of STS instruction.

Figure 36

Problem-Solving Action Groups

Questioning	*Collecting Data*	*Analyzing Data*	*Explaining*
Noting patterns	Observing	Predicting	Describing
Noting discrepant events	Measuring and quantifying	Inferring	Defining
Seeking confirmation	Identifying significance	Graphing	Interpreting
Formulating questions	Selecting variables	Tabulating	Developing mental models
Generating hypotheses	Estimating	Using numbers	Developing physical models
		Correlating	Communicating
		Classifying	

Figure 37

Science Knowledge/Fundamental Environmental Principles

The six conceptual schemes of science knowledge, based on DPI's science guide, and their definitions are followed by specific references to the fundamental principles listed in Figures 4 and 5 (pages 22-31).

Diversity: Natural phenomena display a wide variety of similarities and differences. (Figure 4: B.1.c., B.2.b., B.2.d., B.3., B.4.)

Change: The natural environment is constantly undergoing change. (Figure 4: A.3., A.4., B.2. Figure 5: C.2., C.3.)

Continuity: There is constancy in cause-and-effect relationships which make change explainable. (Figure 4: A.3., B.1.c., B.2.c., B.2.d., B.3.c., B.3.d., B.3.e.)

Interaction: The interactions of matter and energy determine the nature of the environment. (Figure 4: A.3., A.4., B.1.b., B.1.c., B.1.e., B.1.f., B.3.c., B.3.d., B.3.e., B.4.a., B.4.b. Figure 5: A.1., B.1., C.1., C.2., C.3., D.2., D.3., D.4., D.5.)

Organization: Related systems within systems comprise the universe. (Figure 4: A., B.1., B.2.e., B.4.)

Limitation: Natural phenomena are limited by the fundamental nature of matter and energy. (Figure 4: A., B.1.d., B.3.d., B.4.b.)

The subgoals of citizen action skills and citizen action experience are entirely STS education because they seek to provide students with the necessary skills and experiences to go beyond an issue-awareness level and to gain the capabilities needed to take action on issues. STS education all too frequently concentrates on the acquisition of knowledge as a vehicle to acquire citizen action skills and experience. The issue itself is secondary because it may be resolved, entirely or in part. But the skills developed in investigating the issue are applicable to issues students will face throughout life.

Second-Language Education

A Guide to Curriculum Planning in Foreign Language (DPI, 1985) provides two important reasons for studying a language other than English. The first is that students are already living in a global age which will become even more global in the future. The study of a second language not only involves acquiring proficiency in the language but also an understanding of how to interact in the culture of the people who speak it. A second reason is that the concept of the United States as a melting pot has become submerged, and the recognition of a multiethnic society has emerged.

One reason the study of a second language is very important to environmental education is because of the global nature of environmental education. Environmental problems and issues cross international boundaries, and it is important for people from different countries with different cultures to be able to communicate effectively with each other and to understand the cultural contexts in which environmental problems and issues arise. A second reason is a need to be able to communicate concern about environmental issues with other people, especially students, who have limited English-speaking ability.

Some examples of how second-language instruction might contribute to environmental education include the following:

- Students read environmental articles in the language of the country from which that article comes and perform related activities (for example, about international efforts to preserve an endangered species, such as a polar bear, and use the vocabulary and information learned to compose a diary entry representing a day in a polar bear's life).
- Students correspond with students of their own age in other countries in order to discuss environmental problems and issues, local and global. Each writes in the other's language.
- Students (and teachers) might become involved in international environmental education programs such as the Backyard Acid Rain Kit program sponsored by Public Focus, a Canadian environmental organization, or Caretakers of the Environment, an international student-teacher program featuring an annual conference in a different country. The Backyard Acid Rain program publishes some of its materials in French, and the Caretakers of the Environment provides an opportunity to communicate in the languages of the host country and, usually, English, Spanish, and French.

Social Studies Education

The current focus of social studies education is on history and the social sciences—anthropology, economics, geography, philosophy, political science, religious studies, psychology, and sociology. *A Guide to Curriculum Planning in Social Studies* (DPI, 1986) lists four goals for social studies education. Related subgoals of environmental education appear in parentheses following each social studies goal statement.

Knowledge

To help students acquire knowledge that enables them to

- explain the process and dynamics of social/political decision making while demonstrating effective citizenship skills (knowledge: achieving harmony; citizen action skills; and citizen action experience subgoals).
- identify, explain, and apply economic principles and concepts that affect people in all societies (knowledge subgoal: humans as ecosystem components).
- apply geographic concepts to people/environment relationships (knowledge and citizen action experience subgoals).
- demonstrate an awareness of the roles of conflict, cooperation, and change in human affairs (knowledge: achieving harmony; citizen action skills; and citizen action experience subgoals).

Each generation must be taught how to construct the world, because a cosmos is a human invention, or more precisely an artifice of culture.
—David Oates

Democratic Principles, Beliefs, and Values

To help students acquire democratic principles, beliefs, and values such as: cooperation, diversity, equality, freedom, justice, privacy, human dignity, responsibility, and truth (environmental ethic subgoal).

Participation and Civic Service

To help students acquire experience in exercising the rights and responsibilities of citizenship (knowledge: achieving harmony; citizen action skills; and citizen action experience subgoals).

Skills

To help students acquire skills that enable them to think and reason effectively: foundational skills such as observing, classifying, ordering, understanding spatial relationships; processing skills such as predicting, translating, measuring, interpreting, inferring, hypothesizing, imagining, quantifying, analyzing; and operational skills such as searching, participating in groups, communicating, creating/interpreting models, making social judgments, decision making (perceptual awareness, citizen action skills, and citizen action experience subgoals).

A Guide to Curriculum Planning in Social Studies also lists 15 major themes for social studies education. At least seven of them are directly related to environmental education.

Instead of implying that the ideals we cherish are safely embalmed in the memory of old battles and ancestral deeds, we should be telling [young people] that each generation refights the crucial battles and either brings new vitality to the ideals or allows them to decay . . . .
—John Gardner

Citizenship

To help students become effective citizens in a democratic society, social studies education is designed to develop informed, analytical, committed, involved citizens. In environmental education, the subgoals of knowledge (achieving harmony), citizen action skills, and citizen action experience all are directed toward this same end.

Government and Authority

Social studies education helps students understand the function and role of government and authority in a democratic society. In environmental education, the subgoals of knowledge (achieving harmony), citizen action skills, and citizen action experience all are directed toward this same end.

Human Rights

An understanding of human rights at the individual, group, or societal level is another theme of social studies education. *Our Common Future*, which was discussed in section 2, refers to the fact that human rights are inherently a part of any concern regarding the environment and development, especially in terms of sustainable development. Sustainable development at all levels, local through global, is a major concern of environmental education.

Independence and Interdependence

An emerging concern in social studies education is for providing a global perspective in instruction. Four elements providing such a perspective to education are

- a study of human values, both universal values and the diverse human values held by different cultures;
- a study of global economic, political, ecological, and technological systems;
- a study of global problems and issues dealing with peace and security, development, environment, and human rights; and
- a study of global history, of how universal and diverse human values, global systems, and global problems and issues developed over time.

A global perspective stresses both the independence and interdependence of all human endeavors. Environmental education also stresses this idea.

Scarcity and Choice

Social studies education is designed to help students recognize a fundamental conflict between unlimited economic needs and wants and limited natural and human resources. The well-known paper "Tragedy of the Commons" by Garrett Hardin (1968) deals with scarcity and choice. This theme is an important one in environmental education, especially in the knowledge subgoal section on humans as ecosystem components.

Stewardship of Natural and Human Resources

This theme is a critical one for social studies education to deal with and is obviously of major importance to environmental education. Much of the subgoals of knowledge (humans as ecosystem components) and environmental ethic deal with this theme.

Survival Issues and Future Alternatives

Issues dealing with global survival, such as those discussed in *Our Common Future* (section 2), are within the realm of social studies education. Alternative futures also must be considered.

Another aspect of social studies education that has a strong relationship to environmental education is science, technology, society (STS) education. This topic was discussed in science education, but it is so important that it needs to be discussed in this section as well. Many of the world's problems and issues result from the use and misuse of technology, and studying them demands an understanding of science and technology as well as certain social studies.

For example, if the problems and issues resulting from the use of agricultural chemicals are considered, knowledge about growing crops (agriculture, biology, technology education), energy use and conservation (science, technology education), chemical manufacture (chemistry, physics, technology education), the need and demand for more and better food (sociology), and all sorts of economic and political factors are important. To adequately address the issues involved in the use of agricultural chemicals, the interrelationships among all these elements must be studied. The importance of social studies educators working closely with science and technology educators in STS education should be apparent.

Figure 38 provides examples of how various environmental topics might be utilized in various social studies courses at each grade level. The subject area column reflects a sequence suggested in *A Guide to Curriculum Planning in Social Studies.*

Our honeymoon with the planet is over. We must take our marriage to the earth seriously. We can't divorce it—but it can divorce us.
—Noel McInnis and Richard Heiss

Figure 38

Potential Environmental Topics for Social Studies Courses

Environmental Topic	*Course Emphasis / Title (Grade Level)*	*Subject Area Unit / Topic*
Different environments	Social living (K)	Environments we live in
Energy: increasing use	Family, school, neighborhood (1)	Contrasting then and now
Recycling	Local communities (2)	Waste disposal
Farmland preservation	Communities around the world (3)	Rural communities
Great Lakes water diversion	Wisconsin and the region (4)	Living in Wisconsin: the Great Lakes
Energy sources	American heritage (5)	The Industrial Revolution
Rainforest destruction	Cultural perspectives (6)	Brazil
Water quality	Global connections (7)	Ways of life in the Eastern Hemisphere: Egypt
Soils and U.S. history	U.S. studies (8)	The westward movement
Investigating environmental issues	Citizenship (9)	Effective citizenship
People-environment relationships	World studies (10)	Eastern religions
Pesticides: Agent Orange	U.S. history thematic approach (11)	The Sixties: Vietnam
Ecological/economic impacts of General Sherman's March to the Sea	U.S. history thematic approach (11)	Civil War
Environmental Protection: EPA	Political science (9-12)	Independent agencies: the EPA
Impacts of acid deposition	World geography/global studies (9-12)	Global environmental issues
Attitudes toward land and nature	Anthropology (9-12)	Native American cultures
Western U.S. energy developments	Economics (9-12)	Natural resources
National parks	Philosophy (9-12)	Aesthetics of natural areas; nature and physical/mental health
Energy use in 2000	Future studies (9-12)	Lifestyles

Technology Education

The curriculum model presented in *A Guide to Curriculum Planning in Technology Education* (DPI, 1988) includes the study of four major systems—communications, construction, manufacturing, and transportation. Their study is organized on four levels.

- Level I: Awareness of technology: Students in grades K-5 learn about technology in science, mathematics, language arts, and other subject areas.
- Level II: Introduction to technological systems: Middle school students receive a comprehensive introduction to the four technological systems in a formal course.
- Level III: Exploring technology systems: Middle school and early high school students explore in-depth one or more of the four technological systems, each as a separate course offering.
- Level IV: Electives: High school students are involved in an in-depth study of elements of a technological system. A list of possible courses, adapted from DPI's technology education guide, is shown in Figure 39.

Figure 39

Possible Senior High School Elective Technology Education Courses

System	*Course Emphasis*
Communications	Graphic communications Electronic communications Light and acoustic communications
Construction	Planning processes for construction Constructing and servicing structures Managing construction processes
Manufacturing	Manufacturing materials and processes Designing products/planning manufacturing Managing production systems
Transportation	Technical elements of transportation Planning and designing transportation systems Processes for transporting humans and goods

Many environmental elements are recommended for inclusion in technology education courses at all levels. For example, the study of communications systems includes a concern for industrial impacts—economic, political, attitudinal/value, aesthetic, and environmental. The study of planning processes for construction includes a concern for erosion from construction sites. In studying manufacturing systems, not only are finished goods considered to be output, but scrap and environmental pollution as well. And in the study of transportation systems, the effects on land use, aesthetics, natural conservation, noise,

impacts on neighborhoods, and environmental pollution are included as topics for study.

As previously noted in the discussion of science and social studies education, technology education has an important role to play in science, technology, society (STS) education. The ideal approach would be for staff from these three subject areas to collectively plan and teach about STS issues.

Since most formal technology education is offered at the middle and senior high school levels it can make a major contribution to the subgoals of knowledge (humans as ecosystem components and achieving harmony), citizen action skills, and citizen action experience.

Attaining the Subgoals

The preceding discussion is presented in the context of the subject areas and explains the relationships between subject areas and the subgoals of environmental education. The following is presented in the context of the subgoals of environmental education and identifies the subject areas having major or minor responsibility in achieving those subgoals.

Figure 25 (page 76) designates which subgoals are to receive major (or minor) emphasis at each of four levels. Figure 40 identifies the subject areas having major or minor responsibility for contributing to the attainment of each subgoal of environmental education.

Curriculum planners might use Figure 40 as a checklist to determine whether subject area curriculum plans adequately address the subgoals of environmental education.

Figure 40

Subject Area Responsibility

Perceptual Awareness

Grade-Level Range	Major Responsibility	Minor Responsibility
K-3	Art education Communication arts education Mathematics education Science education Social studies education	Dance education Music education
3-6	Art education Communication arts education Science education Social studies education	Dance education Mathematics education Music education
6-9	Art education Dance education Mathematics education Science education Social studies education	Communication arts education
9-12	Art education	Communication arts education Dance education Science education

Knowledge

Grade-Level Range	Major Responsibility	Minor Responsibility
K-3		Art education Health education Science education Social studies education
3-6	Health education Science education Social studies education	Art education Dance education
6-9	Health education Science education Social studies education	Agriculture education Art education Business education Dance education Family and consumer education Physical education Technology education
9-12		Agriculture education Art education Business education Family and consumer education Health education Physical education Science education Social studies education Technology education

Environmental Ethic

Grade-Level Range	Major Responsibility	Minor Responsibility
K-3	Art education Communication arts education Science education Social studies education	Dance education Health education Mathematics education Music education
3-6	Art education Communication arts education Health education Music education Science education Social studies education	Dance education Family and consumer education Technology education
6-9	Art education Communication arts education Health education Science education Social studies education	Agriculture education Business education Dance education Family and consumer education Music education Physical education Technology education
9-12	Art education Communication arts education Family and consumer education Health education Science education Social studies education	Agriculture education Business education Dance education Music education Physical education Technology education

Citizen Action Skills

Grade-Level Range	Major Responsibility	Minor Responsibility
K-3		Art education Communication arts education Mathematics education Science education Social studies education
3-6		Art education Communication arts education Health education Mathematics education Science education Social studies education
6-9	Communication arts education Science education Social studies education	Agriculture education Art education Family and consumer education Mathematics education Technology education
9-12	Agriculture education Communication arts education Health education Science education Social studies education Technology education	Art education Business education Mathematics education

Citizen Action Experience

Grade-Level Range	Major Responsibility	Minor Responsibility
K-3		Art education Communication arts education Science education Social studies education
3-6		Art education Communication arts education Health education Science education Social studies education
6-9		Art education Communication arts education Health education Science education Social studies education
9-12	Agriculture education Family and consumer education Health education Science education Social studies education Technology education	Art education Communication arts education Mathematics education Physical education

Courses

Environmental education is no longer a luxury. It is a necessity. It must become part of a worldwide human curriculum. An environmentally aware population can break old habits, develop new alternatives, and prevent the destruction of valuable planetary species and ecosystems. Only such awareness can assure that our earth household will be properly maintained for generations yet to come.
—Jim Lenfesty

The introduction to this section explained that most of what is called environmental education content is already present in most traditional subject-area curricula. Curriculum planners must identify and focus on that environmental content or utilize methodology that allows for the achievement of certain kinds of environmental education objectives. If this is done carefully and completely so that all courses include appropriate environmental content, the need for specific courses in environmental education should be minimal. However, strong interest in an environmental education course among students should be recognized and satisfied if at all possible.

Some Wisconsin senior high schools and middle/junior high schools already offer semester or year-long environmental education courses with titles such as conservation of natural resources, environmental studies, or environmental science. The content of these courses varies greatly. Some of these courses follow the guidelines of this publication, but many do not. The following guidelines are offered for use in assessing existing courses and for developing new ones.

Environmental education courses should

- be elective and available to all students in their junior and/or senior years of high school.
- be taught by an interdisciplinary team which, because of the recommended content, includes a social studies teacher if at all possible.
- allow students to earn either one-half credit for a semester course or one credit for a year-long course split between the subject areas in which teachers are certified (science and social studies, social studies and English, and so forth).
- not supplant or limit the emphasis on the environmental content of any subject area course (for example, history, chemistry, American literature).
- have the majority of the instructional objectives based on the subgoals of citizen action skills, citizen action experience, and environmental ethic—the three subgoals recommended for emphasis at the senior high school level.
- have a definite issue investigation/resolution orientation, with an initial investigation of an issue by the entire class, followed by the investigation of at least one issue each semester by each class member or small teams. If possible, the issue investigated by the class should be of local significance while the issues investigated by individual students or teams might be at any level, local through universal.
- be planned and taught utilizing the suggestions regarding the teaching of controversial issues made in section 6.

If there is strong interest among middle/junior high school students for an environmental education course, these same guidelines should apply except that the majority of objectives should be based on the subgoals of knowledge, citizen action skills, and environmental ethic.

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6

In section 5, it was stated that fulfilling the needs of students should never be subordinated to fulfilling societal needs or the demands of disciplines. If this principle was followed by every educator in every instance, and fully supported by society, student difficulties and educational problems would be substantially reduced. Noel McInnis emphasizes this point in his book *You Are an Environment* by describing the results of much current educational practice as "learning to become impossible."

"Take an average human child, and subject that child to 12 years of daily prolonged exposure to an environment which does the following:

- confines the child's body to a very limited territory,
- confines the child's energy to a very limited activity,
- confines the child's senses to very limited stimulation,
- confines the child's sociability to very limited interaction with the child's peers,
- confines the child's mind to very limited experiences of and with the world around the child,
- separates learning from living and doing,
- subordinates the child's initiative to that of others,
- assumes the child's ignorance,
- emphasizes the child's mistakes, and
- disregards the child's feelings.

What do you get?"

There are many ways of teaching. Not all of these are ways of helping people learn.
—Earth Science Teacher Education Project

McInnis then cites the results of educational research in generalizing how human beings learn. They

- have a natural desire and potential to learn,
- learn best when the object or subject of their learning is perceived as contributing to their own needs or objectives,
- learn best when both their feelings and their intellect are involved in the learning process,
- learn best when they contribute to their self-evaluation, and
- learn best when they have learned on their own initiative.

Thus education need not be a process of "learning to become impossible," it can be just the opposite if activities are selected with consideration of what is known about the way that children grow and develop.

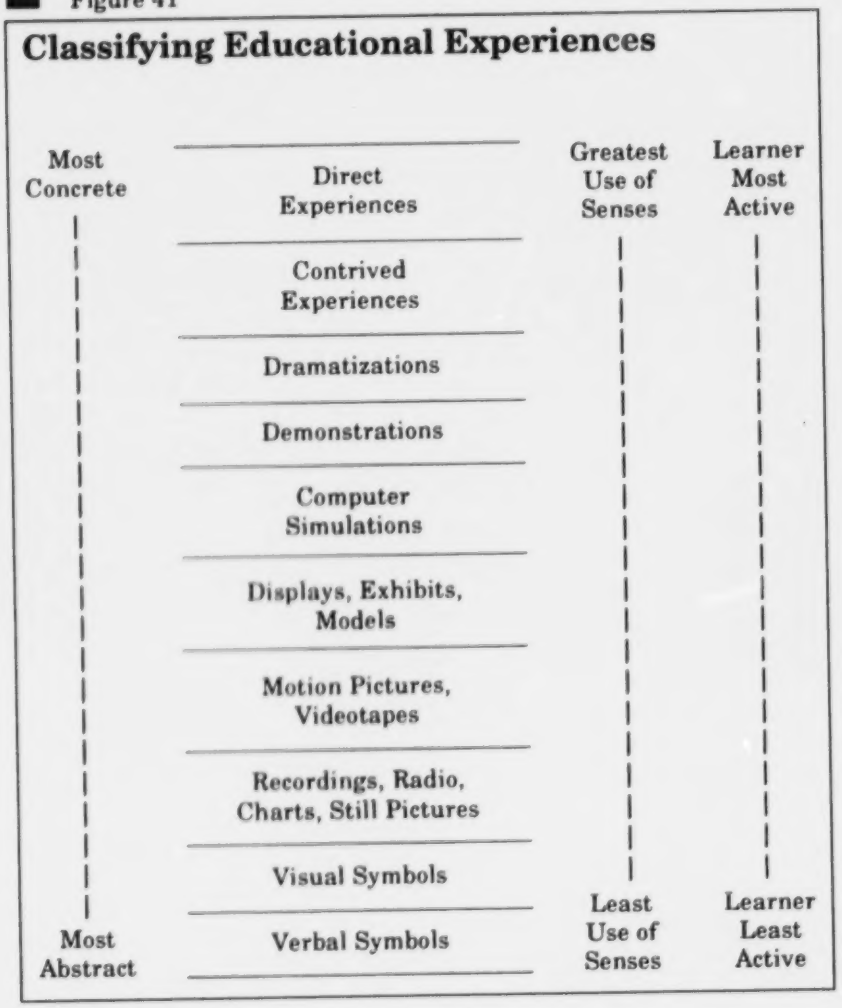
Joseph R. Kelly and Edwin P. White considered this principle in developing a set of recommendations for selecting teaching/learning activities in environmental education. Their statement, "Characteristics of Children and the Implications for Environmental Education," appears in Appendix G. It is recommended that Appendix G be studied before curriculum plans or learning activities are developed.

Classifying Educational Experiences

There are many kinds of educational experiences, some very direct and concrete, others abstract and symbolic. A classification scheme for educational experiences, in which they are arranged from most concrete

to most abstract, is shown in Figure 41. In such an array, a transition from the greatest use of the senses and the greatest learner activity to the least use of the senses and the least learner activity is evident.

Figure 41



The First Law of Environmental Education: An experience is worth 1000 pictures.
—Noel McInnis

Direct Experiences

Direct experiences are those in which individual learners have an opportunity to use all of their senses—hearing, taste, sight, touch, and smell—in an unabridged way. For example, very young children might be asked to search for fall leaves with different textures, colors, or some other attribute in a natural area. Middle school children might be asked to design and administer a survey instrument that collects information on how the public feels about an environmental issue in their community and to analyze and interpret that information. High school students might be asked to monitor a local stream for its biological and

chemical characteristics and to be alert for changes that might be related to environmental problems.

Contrived Experiences

Contrived experiences are similar to direct experiences but are edited so as to omit certain elements of direct experiences in order to make them easier to understand. The editing might reduce the size and/or the complexity of the real-life situation. For example, an experience involving the use of models is probably a better way to teach elements of city planning than a direct experience involving traveling through traffic over miles of streets and viewing scores of buildings and other elements of a city. The model meaningfully summarizes and condenses a great deal of information, making an area of many square miles easy to comprehend. However, excursions of limited duration into a city provide supplemental direct experiences that are very valuable and also should be provided.

Another example of a contrived experience might be the study of a pond ecosystem in an aquarium, which is a good beginning but does not substitute for direct experiences involving real ecosystems.

Dramatizations

Dramatizations reconstruct other people's experiences. They omit some of the unimportant and confusing elements of a situation while stressing the important ideas. Students can participate in a dramatization by acting out the experience or by watching others act it out. The intended message may be conveyed to the student by either method. Role playing, a part of many simulation activities, is an example of this kind of experience. It is valuable as a means of learning because it helps students gain a sympathetic understanding of other people's feelings, thus providing new insights into their own lives. By acting out the part of another person, students become more aware of, and develop empathy for, the position of a person embroiled in a difficult situation.

Demonstrations

Demonstrations are visualized explanations of important facts, ideas, processes, or techniques that are generally done by one person or a small group before a larger group. A demonstration is often performed because it is not possible to provide an individual or even small group of students with the materials and equipment needed in order to provide a direct or contrived experience. Time and safety factors associated with the topic of the demonstration also may influence the decision to use the demonstration as an alternative to some other approach.

Demonstrations may use other teaching approaches shown in Figure 41. A good demonstration often involves a dramatic presentation, models, specimens, objects, photographs, videotapes, computers, and written symbols.

Computer Simulations

Computer simulations also edit out elements of direct experiences. They are excellent vehicles for demonstrating interrelationships between interdisciplinary environmental concepts. Four components are usually present: an abstraction of an environment; rules for how the model behaves or models interact; the freedom to interact with the simulation to develop strategies; and feedback that approaches reality. Compared to direct experience, computer simulations allow students to investigate many factors within a reasonable time frame, visualize conceptual relationships, change relations and observe the results, exercise and develop their judgment and witness the result of their actions without penalties, experiment without having to use complex laboratory techniques, focus on the most important aspects of the situation, and study more content.

Displays, Exhibits, Models

Displays, exhibits, and models often are self-teaching. They should focus on a single idea and provide a dramatic effect. They may use photographs, models, charts, posters, audiovisual equipment and materials, computers, or real objects, alone or in combination. Viewers might be provided opportunities to use their senses (for example, touch something), thus greatly enriching the experience. By constructing displays, exhibits, and models, students can demonstrate their understanding of the central idea involved.

Displays, exhibits, and models may be used in a variety of ways—to introduce a unit or activity, to transmit information to students, or to serve as a culminating activity at the end of a unit or series of lessons.

Motion Pictures, Videotapes

Motion pictures and videotapes compress both time and space, thus omitting unnecessary and unimportant material and allowing for concentration on selected key points. Slow-motion photography can show movements that are too fast to be seen at their actual speed, and time-lapse photography may be used to condense and accelerate slow movements. Close-ups, wide-angle photography, and animation are other techniques that make special contributions to understanding subject matter.

The use of broadcast television to present events occurring at the moment (such as a public hearing on an environmental issue, a flooding river, or a nuclear catastrophe) does not condense time or space but provides an exciting emotional element to instruction. In recent years numerous valuable programs dealing with the environment have been aired by broadcast television.

Recordings, Radio, Charts, Still Pictures

Recordings, radio, charts, and still pictures convey information by providing experiences using either audio or visual stimuli. They may be

used with individuals or groups. Recordings and radio may be useful in working with students with reading problems. Charts and still pictures may represent persons, objects, or events and are intended to be interpreted by the viewer. Simple drawings may be substituted for photographs that include too many ideas or do not offer a sharp focus on information to be learned.

Visual Symbols

Visual symbols and verbal symbols are the most abstract approaches to teaching and learning. Very little physical activity is involved in these types of experiences. Examples of visual symbols include a bell to mark the location of a school, a stork or red cross to represent a hospital, a black line to represent a road, a blue line to represent a stream, green coloration to represent forested areas on a map, printed numbers, or letters combined to form words. The chalkboard and overhead projector are two types of devices widely used to present visual symbols.

I have five senses you must reach if I'm to learn and you're to teach. With taste, touch, smell and sight so clear, why must I receive all sense by ear?
—C. Harold Fabler

Verbal Symbols

Verbal symbols and visual symbols differ primarily in the sense organ used to receive stimuli. A spoken word such as ecosystem is a verbal symbol while the printed word ecosystem is a visual symbol, but both cause the individual to recall his or her concept of what constitutes an ecosystem. Verbal symbols may represent a concretion (tree), an idea (population control), a formula ($E=MC^2$), a moral principle (Leopold's Land Ethic), or any other symbolic representation of experience.

Helping Students Develop Perceptual Awareness

As indicated in Figure 25 (page 76), a K-12 environmental education program begins with a major emphasis on the development of perceptual awareness in grades K-3. It may be useful to review the discussion of the perceptual awareness subgoal before considering the selection of strategies for developing perceptual awareness.

Although an individual might develop a degree of perceptual awareness from random experiences, a planned program designed to achieve specific objectives enhances and expedites such development. In order for these experiences to be successful, four conditions must be present.

- The individual must be physically comfortable.
- The individual must have an open, receptive attitude.
- There must be environmental stimuli that the individual receives.
- The individual must respond to the stimuli by receiving them and processing the information they contain.

If any of these conditions is missing or deficient in some way, the possibility of developing perceptual awareness is decreased significantly.

For example, some students may be frightened or apprehensive about certain environments, such as forests or wetlands, especially if these

environments are unfamiliar to them. These fears may have resulted from earlier experiences or teaching (intentional or unintentional) provided by parents, teachers, or others. They must be dealt with before these students can learn to explore, investigate, and enjoy such environments.

Early perceptual awareness experiences should be directed toward helping students become more effective in perceiving and discriminating among stimuli—in using a single sense to observe an object or event in order to identify attributes of the object or event. The following are examples of attributes students might look for:

Activity is a law of childhood. Accustom the child to do—educate the hand. —Edward A. Sheldon

Using the sense of sight:

- What color is the object?
- Is the object bright or dull?
- Is the object high up or down low?
- Is the object long or short?
- Is the object large or small?
- Is the object smooth or rough?
- Is the shape of the object square, round, or triangular?
- How many objects are there?
- How long did the event take?
- Is the object at rest or moving?
- In what way is the object moving? Is it swaying back and forth, moving in a straight line, or moving in a curved line?

Using the sense of touch:

- Is the object warm or cold?
- Is the object wet or dry?
- Is the object smooth or rough?
- Is the object sticky or slippery?

Using the sense of smell:

- Does the object have an odor?
- Is the odor strong or weak?
- Does the object have a pleasant odor or an unpleasant odor?
- Does the object smell like something else?

Using the sense of hearing:

- Does the object or event sound loud or quiet?
- Does the sound of the object or event remind anyone of other objects or events?
- Does the sound of the object or event have a high pitch or low pitch?

Using the sense of taste:

- Does the object taste sweet, tart, spicy, or salty?
- Does the taste of the object remind anyone of the taste of some other object?

Subsequent experiences might be directed toward helping students discover more than one attribute of an object or event using a single sense (What is its color? Does it look smooth or rough?); locate an object or event with a specific attribute (find a very smooth stone); or locate more than one object or event with a particular attribute (find all the yellow flowers, look for the objects being moved by the wind). Experiences like these then would be followed by those in which multiple

I sincerely believe that for the child, and for the parent seeking to guide him, it is not half so important to know as to feel. If facts are the seeds that later produce knowledge and wisdom, then the emotions and the impressions of the senses are the fertile soil in which the seeds must grow. The years of early childhood are the time to prepare the soil. Once the emotions have been aroused—a sense of the beautiful, the excitement of the new and unknown, a feeling of sympathy, pity, admiration, or love—then we wish for the knowledge about the object of our emotional response . . . . It is more important to pave the way for the child to want to know than to put him on a diet of facts he is not ready to assimilate.
—Rachel Carson

senses are used to discover multiple attributes of objects or events (What color is the object? What kind of texture does it have? Is it warm, cool, hot, or cold?). As students improve their ability to perceive and discriminate among stimuli, experiences should begin to focus on developing the ability to process, refine, and extend perceptions—the data or information that is collected through observations using all of the senses. The objectives of these experiences should deal with classifying, sequencing, understanding spatial relationships, measuring and quantifying, inferring, predicting, interpreting, and analyzing.

Well-known early childhood educator David Elkind urges that at least two years of formal education be devoted to helping very young children become efficient observers who use all of their senses to gather information from their environment, refine and extend the use of their senses in order to become even better observers, and efficiently process the information thus gathered. This degree of emphasis also should result in an aesthetic awareness of sensitivity which, as discussed in the perceptual awareness section, is extremely important to the development of an environmental ethic. It also should be remembered that the process skills developed are those skills utilized in exploring environments and constructing knowledge from what is found there.

The process skills involved in perceptual awareness are critical to the instruction of emergent readers. For example, they must be able to discriminate shapes, sounds, syllables, and accents; recognize letters and words; compare and contrast characteristics; order or sequence events; and arrange and classify ideas after observing and considering multiple factors—the same kinds of skills emphasized in helping children develop a perceptual awareness.

The development of process skills is a very personal experience. It occurs only when a person has concrete experiences during which the senses are used to explore the environment. Although students working in groups may contribute to a person's development of process skills, the individual should have an opportunity to work alone if the skill is to be fully developed.

The development of perceptual awareness is primarily the responsibility of teachers at the elementary level, especially teachers of grades K-3. At these grade levels the use of activities that concurrently achieve subject area and perceptual awareness objectives is critical to the success of the program. For example, an activity might be designed to achieve specific communication arts objectives while developing process skills that are part of perceptual awareness. With very young students such an activity might require that each student find an object of interest, study it using all the senses except taste, and become a spokesperson for the object, describing to other class members its attributes and why the student found this object to be particularly interesting. Thus the activity achieves objectives related to the communication art of speaking while enhancing the student's observing skills. A different version of this activity asks older students to select an object in the environment without letting anyone know what that object is, develop a list of words describing the object, and then share the list with other

students as they try to identify the object. This activity achieves communication arts objectives dealing with vocabulary development while further enhancing the student's observing skills.

Although teachers in grades K-3 have the major responsibility for helping students develop perceptual awareness, there may be many older students who have not been provided with ample opportunities to do so. It then becomes incumbent that the teachers of those students provide such opportunities. If this is not done, those students will be at a distinct disadvantage as they try to construct knowledge throughout the rest of their lives.

Helping Students Learn How to Construct Knowledge

Despite what is known about how students construct knowledge (section 4), the dominant mode of instruction in most classrooms continues to be large-group, teacher-controlled lecture and recitation. The teacher determines goals, decides on and presents the content to be learned, tests for recall and understanding, identifies problems to be solved, specifies the approach to be utilized so the "correct" solution is determined, and evaluates performance against his or her predetermined standards and criteria. Instruction is usually based on the dominant instructional tool, the textbook. Textbooks may be an important and appropriate resource but are too often utilized as the principal source of truth, limiting reflective thinking, discouraging thinking about issues, and limiting knowledge. The result may be students who develop into a passive and uninvolved citizenry. Curriculum and instruction based solely on textbooks tend to limit stimulating experiences and inquiry.

It may be useful to review McInnis's description of how education sometimes becomes a process of "learning to become impossible" and what research has to say about how humans learn best, Kelly and White's "Characteristics of Children and the Implications for Environmental Education" (Appendix G), and the work on learning styles by Bernice McCarthy (section 4) before considering how experiences that help students construct knowledge might be selected.

Figure 42 is a representation of general principles to be considered in selecting such experiences for children. These principles include:

- The levels or kinds of learning experiences seem to be related to the age and the degree of sophistication of the learner. Very young students learn best if provided with experiences that are very concrete. Older students, especially those in high school, can learn through more abstract experiences but this does not mean these students should be offered only those kinds of experiences. The more concrete the experience the greater seems to be the retention of learning.
- Abstract experiences appear to be efficient because content can be compressed into less teaching and learning time. But teachers should not make the mistake of choosing abstract experiences solely for the purpose of "covering" material.

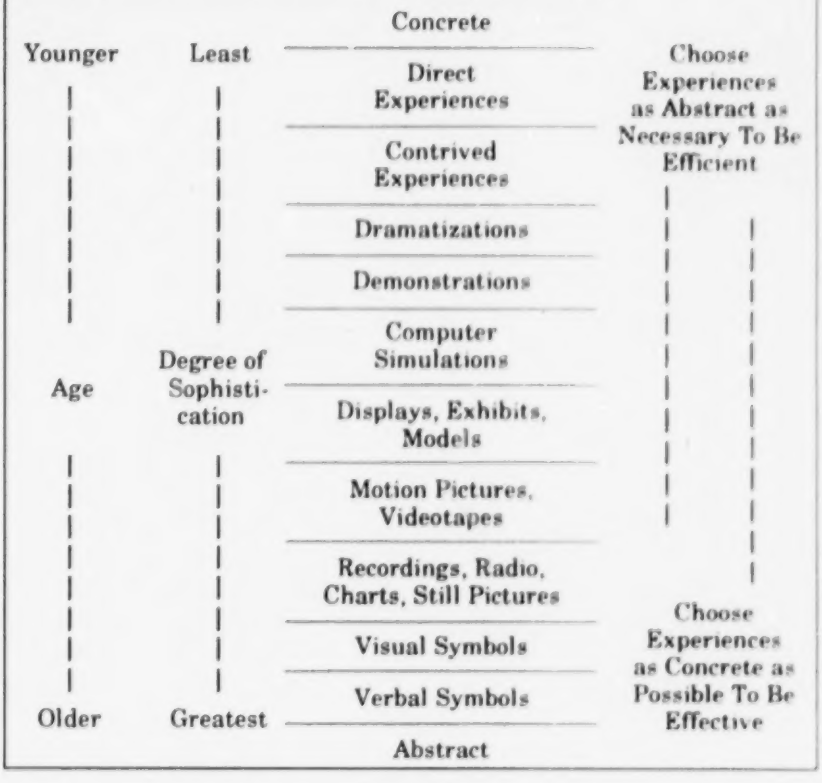
[People] learn largely from [their] own experience and relatively little from hearing or committing to memory generalizations from the experiences of others. Vicarious experiences can educate but must be given life by being meaningfully related to the needs and interests of the learner. To have power, indirect experience must take on the basic quality of direct experience. 'Telling' is an important and common means of education, but that it is the best means is a dangerous myth.
—Earl V. Pullias

- The individual and collective characteristics of the learners involved, the characteristics of the subject matter, and the characteristics of the tasks inherent in learning the subject-matter content should be considered in selecting the kind of experience offered to learners.
- In general, the more concrete the experience the more effective it will be in achieving a learning objective, but a more abstract experience may have to be selected in order for it to be efficient in terms of available resources.

Human beings learn largely from their own experiences and relatively little from hearing or committing to memory generalizations from the experiences of others. Vicarious experiences, especially those at the abstract end of the array of Figure 42, can educate but must be meaningfully related to the needs and interests of the learner; they must take on the qualities of direct experiences.

Figure 42

Cognitive Domain: Selecting Environmental Education Experiences



The process skills that are taught in developing perceptual awareness are the tools used in constructing knowledge about the environment. Knowledge construction (such as concept formation) begins with observing events and/or objects. Other process skills—classifying, sequencing, understanding spatial relationships, measuring and quantify-

ing, inferring, predicting, analyzing, and interpreting—then are employed in processing the information received or in refining and extending the process of observation.

Since concept formation is something that occurs within the individual, the individual must be provided with numerous opportunities to observe actual objects or events if legitimate concepts are to be formed. For example, in introducing a fifth grader to the concept succession (such as the compositional changes occurring in an ecosystem's biological community and in its nonliving environment over time), the student must be provided numerous direct experiences in natural areas where succession is occurring, such as along the edge of a pond, along the edge of a woodland, or on bare rock. The student must have an opportunity to observe the living elements (plants and animals) of these ecosystems. On the edge of a pond the student might observe that different kinds of vegetation—very small floating plants such as algae in the center, larger underwater plants rooted in the pond bottom, plants with floating leaves (such as water lilies) rooted in the pond bottom, plants growing in shallow water but emerging into the air, shrubs growing in wet soil near the pond edge, and finally trees growing where soil is much drier—seem to grow in rings or zones around the pond. A discussion in which this information is processed might reveal that some of the vegetation will die each fall and cause the vegetation rings of the pond to change because of gradual filling, thus introducing the concept of succession at an elementary level. Reading about succession and viewing accompanying diagrams, a videotape, or a motion picture discussing pond succession may be used to reinforce the concept developed through direct experience. However, if reading or viewing is used as the sole means of instruction, the concept that will develop will be that of succession as printed words and diagrams or a videotape or motion picture image with an accompanying narration. The more concrete the experiences offered children, the more complete and permanent the learning.

What makes education environmental is the way it is experienced. *If education is not* experienced *environmentally, then it is not environmental.*
—Noel McInnis

Concepts continue to develop as the result of subsequent experiences. When the student reaches grade 7 or 8, additional direct experiences with pond succession might be offered, experiences in which the student measures elements of the physical environment such as air and soil temperatures, wind, available sunlight, available water, and so forth in each of the vegetation rings. The processing of such data should enable the student to develop a more precise understanding of how and why succession occurs.

Do not try to satisfy your vanity by teaching a great many things. Awaken people's curiosity. It is enough to open minds; do not overload them. Put there just a spark. If there is some good inflammable stuff, it will catch fire.
—Anatole France

At this same level as well as in subsequent years, students should be provided with other experiences dealing with succession, both direct and abstract, some in natural environments and some in human-altered environments. For example, the concept might be broadened through instruction in the social studies by involving the student in direct experiences in which changes that have occurred in urban areas over time are examined.

The teacher must carefully plan what the student is expected to learn before selecting experiences that enhance the desired learning. In recent years the concern for a constructivist view of knowledge and

knowledge production has led to the promotion of concept mapping as a planning, implementation, and evaluation tool for both teachers and students. A brief discussion of concept mapping and how it might be used is provided in Appendix H.

Finally, as Bernice McCarthy and others have shown, individuals have a preferred learning style; they receive and process information differently. Thus in order for each student to have the best opportunity to learn, the teacher must select a variety of activities related to the concept being studied.

Helping Students Develop an Environmental Ethic

In Figure 25, page 76, the environmental ethic subgoal is listed for major emphasis at all grade levels, K-12, suggesting the critical importance of this subgoal. But unfortunately, educational objectives for this subgoal are rarely an explicit part of the curriculum. More frequently, students are taught to accept authority and the so-called important truths about history, government, and other matters. The discussion of the environmental ethic subgoal and the summary of research relating education about the environment to the affective domain (section 3) should be reviewed before considering how experiences that help students develop an environmental ethic might be identified. It is especially important to recall that cognitive and affective factors should be considered together in the teaching-learning process, that knowledge does not exist apart from feelings and emotions.

Figure 43 is a representation of the general principles to be considered in selecting affective educational experiences for students. These principles include the following:

- Different kinds of experiences are related to the age and sophistication of students and to the tasks of forming or changing attitudes.
- In helping young students to form attitudes, or older students to change attitudes, the rich messages of concrete experiences seem to be most effective.
- In helping young students to change attitudes, or older students to form attitudes, almost any kind of experience may be effective, but more abstract experiences are more efficient.
- An experience designed to change attitudes may not be at the same level as one needed to achieve a related cognitive objective even though the cognitive objective is essential to the attitude change.

These principles suggest a changing relative emphasis on the affective and cognitive dimensions of education about the environment at different grade levels as shown in Figure 44.

Figure 44 indicates that the cognitive (knowledge, citizen action skills, and citizen action experience subgoals) and affective (perceptual awareness and environmental ethic) domains are taught simultaneously at all grade levels but with a different emphasis at different grade levels. Positive attitudes developed in the early grades are further developed

Figure 43

Affective Domain: Selecting Experiences for Environmental Education

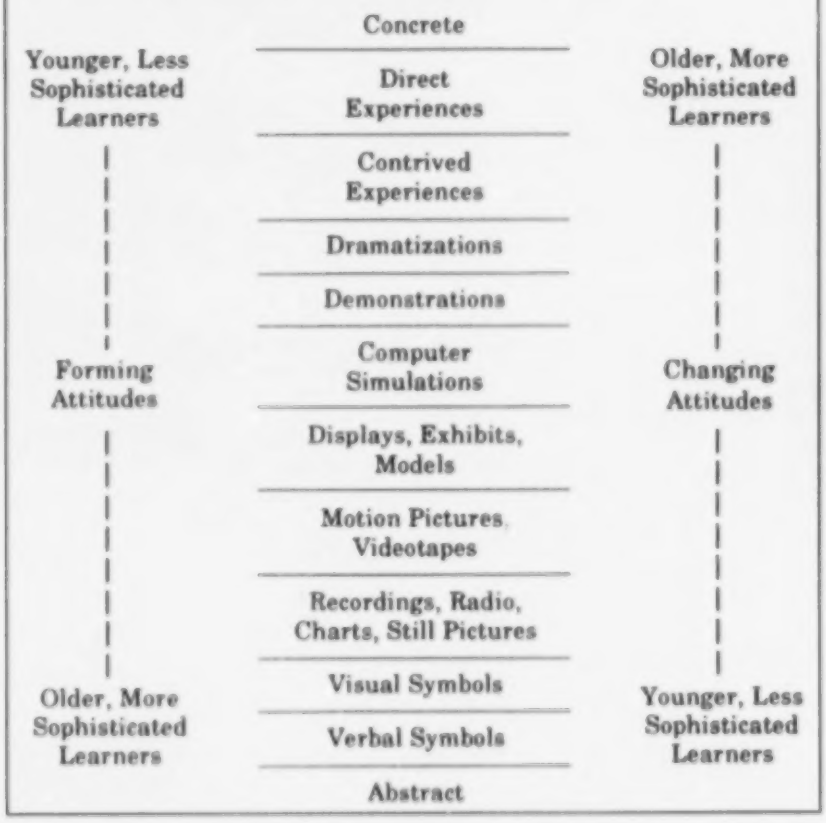
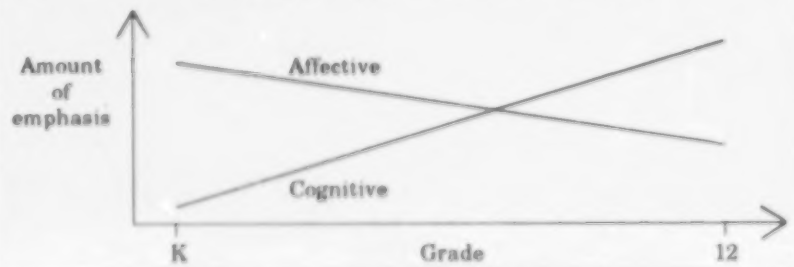


Figure 44

Relative Emphasis on the Cognitive and Affective Domains at Different Grade Levels

Reprinted with permission from "What Research Says to the Educator: Part Two: Environmental Education and the Affective Domain" by Louis A. Iozzi, *The Journal of Environmental Education* (Washington, DC: Heldref Publications) 20.4 (Spring 1989).



We need not and should not pass judgment on particular values; however we must provide a process through which students, and thus society, may begin to identify values and examine the problems likely to be faced.
—Peter DeDecker

and reinforced in the upper grades. Knowledge constructed by students in the early grades while learning the process skills involved in perceptual awareness becomes a basis for further knowledge construction, the development of citizen action skills, and the acquisition of citizen action experience in subsequent grades. This changing emphasis is also indicated by Figure 25, page 76.

Examples of concurrent teaching for both affective and cognitive outcomes may serve to clarify and support the above points. An example for each of four grade-level groupings is provided.

Primary Grades

A teacher takes students to a natural area to involve them in an activity in which they will have an opportunity to use most, if not all, of their senses. They discover the attributes of numerous objects in the natural area by feeling, smelling, listening to, and looking at them. Within limits, a sample of some of the objects may be collected and, later, taken back to the classroom. The students also record what they have seen by drawing pictures, recording sounds, and writing. They also might act out some of their observations—grass swaying in the breeze, the flight of a bird, the fluttering of a leaf, the movements of a twig floating down a small stream. Negative things, such as vandalism or litter might also be observed, corrected if possible, and recorded in some way.

Love—Trust
Explore—Joy
Invent—Feel
Share—Care
Learn—Touch
Grow—Become
—American Geological Society Poster

Before leaving the natural area, the teacher might ask class members to sit in a circle in order to give each student a chance to share with the others what he or she liked best about the natural area. The teacher might ask questions like: If you were a dandelion or a rabbit, would you like to live here? Why or why not? How would you feel if someone would damage or destroy this area? Would you like others to be able to enjoy this area? How might we share the happy experiences we had here with others? When the students return to the classroom they might write letters to their parents or friends to tell them about their experiences, construct a collage of the items they brought back with them, and/or develop a bulletin board display of their drawings and writings. Activities like these help students learn to value natural areas like the one they visited and develop positive attitudes regarding the importance of such areas.

Upper Elementary Grades

As part of a social studies unit a teacher splits the class into groups of different sizes to represent the relative populations of various countries. One group has only one person, another two, another 14 or 15, and so forth. The teacher then produces bags of popcorn of different sizes, some large and some very small. The different sizes represent the relative amounts of resources, especially food, available to the people of various countries. The bags are distributed to the various groups, the larger to smaller groups, the smaller to larger groups. Student reactions vary from satisfaction to strong dissatisfaction, depending on the group to

which the student belongs. Members of the large groups are very unhappy with their individual shares and complain rather loudly about the inequality in the distribution.

The meaning of the activity is brought out in the ensuing discussion. Concepts dealing with global geography, economics, government, and other topics may be developed. Environmental issues such as human population problems, desertification, water pollution, urbanization, and others may be addressed. Why developing nations are tempted to destroy resources such as rainforests in order to survive might also be discussed. Values such as fairness, generosity, kindness, sharing, equality, justice, happiness, and others may emerge and may be discussed.

Middle/Junior High School Grades

In a social studies course such as civics or citizenship, environmental issue case studies—summaries of how people have dealt with environmental issues—might be used to teach how citizens can and should become involved in the activities of governments. Properly selected case studies enable students to learn how to define an issue; identify the parties involved in an issue; determine what these parties believe about the issue and what kind of values those beliefs represent; analyze the potential environmental, economic, and social impacts of each proposed solution; and examine how the issue was eventually resolved and what the impacts of the final resolution were. Simulations in which students role play the people involved in an issue rather than just reading about them can also be utilized and are especially valuable because they force students to defend positions on issues that they might not otherwise consider seriously.

Students also might be asked to conduct an individual or group investigation of an environmental issue in which they do all of the above but additionally learn how to collect information from secondary sources (such as authorities, printed matter); how to use surveys, questionnaires, and opinionnaires to collect information from primary sources such as the people affected by and directly involved in the issue; how to analyze all the data and other information they collect; how to examine their own values and to determine their personal position on the issue; and how to develop and implement an action plan to resolve the issue. This action plan could then be implemented if the teacher felt the individual or group was mature enough to do so.

Activities like this help students examine the value positions of other people, identify their own value positions on the issue involved, and compare these value positions to those most beneficial to social and environmental welfare.

You can teach with *your students,* with *your knowledge, and* with *your environments . . . . On the other hand, you can . . . teach* at *your students* about *your knowledge about your environments. In the first example you are educating environmentally. In the second case you are* perpetuating the gross error *which underlies our current environmental predicaments . . . .*
—Noel McInnis

Senior High School Grades

In a U.S. history class, students might be involved in an outdoor simulation in a wooded area in which they role play pioneer families creating a Wisconsin forest homestead in the mid-1800s. Each group is

given a list of the material goods, the livestock, seeds, and other items available to them and assigned a different arrival time—spring, summer, or fall. Each group then must plan the steps it would take in order to establish a homestead, including a determination of the order of these steps. Group members would need to determine sites for housing, other buildings, agricultural fields, and so forth. Decisions would have to be made to ensure that the necessities of life (such as food, water, and shelter) would be provided, land would be cleared, and livestock would be protected from predators.

During an ensuing discussion in which each group shares its plan with the rest of the class the settlers' apparent attitudes and values regarding the wilderness could be identified and contrasted with the prevailing societal attitudes and values of the historical period and those of today. The appropriateness of the settlers' actions also could be debated and contrasted to those of the lumber barons or similar groups of the period and today.

Helping Students Develop Citizen Action Skills

The citizen action skills subgoal should be a minor emphasis at the K-3 and 3-6 levels and a major emphasis at the 6-9 and 9-12 levels. A minor emphasis means that the amount of instructional time devoted to developing citizen action skills should be limited, and it is more important to devote the majority of instructional time to the objectives related to the subgoals of perceptual awareness, knowledge, and environmental ethic. The discussion of the citizen action skills subgoal (section 3) provides a rationale for citizen action education and suggests objectives for citizen action skill development at three levels—lower elementary, upper elementary, and middle/senior high school. Figure 25 (page 76) and the subgoal discussion should be reviewed before considering the identification of activities for developing citizen action skills.

The subgoal discussion recommends that teachers concentrate on developing certain kinds of generic skills at both the lower and upper elementary levels and, additionally, communication and cooperative work skills at the upper elementary level. But it also indicates that this does not preclude involvement of students at these levels in true citizen action experiences appropriate for their age and maturity levels, if the issue is one of concern to the students and not teacher-generated for a purpose approaching indoctrination. Projects such as litter pick-up, recycling, and building simple bird feeders are appropriate for this level. Occasionally the teacher-led investigation of a real environmental issue is appropriate as well. Issues selected for study should be concrete and easily understood by the children. Local issues are especially valuable because the students are probably highly motivated by them and can observe the results of their efforts.

At the middle and senior high school levels the instructional emphasis should be on developing the investigation/resolution skills of the citizen action skills subgoal. In summary, these include the ability to

- identify and clearly state environmental issues.
- identify the individuals and groups participating in attempts to resolve the issue and the value positions they represent.
- evaluate the solutions to the issue proposed by the participants for their potential environmental and social impacts.
- gather additional information about the issue from secondary sources, such as experts on aspects of the issue and what they have written about it.
- gather information from primary sources such as people involved in and/or affected by the issue.
- interpret the information collected.
- develop an action plan to resolve the issue.
- implement and evaluate the results of their action plan.

There are three very useful strategies that may be employed to help students acquire these citizen action skills. The first, the issue case study approach, was described on page 131 in the middle/junior high school example of how instructional objectives in the affective (environmental ethic) and cognitive (knowledge) domains can be attained concurrently. The case study approach requires students to analyze a written summary of how an environmental issue arose and was resolved. The other two strategies, group issue investigation and individual issue investigation, are very similar in that they require students to actually identify, investigate, and develop a plan for resolving an environmental issue. The two attempt to help students learn citizen action skills in essentially the same manner. Figure 45 summarizes the differences in these two approaches.

It is psychologically easier to set out a program of saving the world than it is to get down to the 'nitty-gritty' of saving the sandlot next door for the use of the community's children.
—Dennis Weibel

The time requirement for instruction in citizen action skills using these strategies may appear to be excessive. However, in both strategies several subject areas are frequently involved, and instruction can be planned accordingly. Learning how to identify, state, and analyze issues in order to determine who the participants are, what they believe and value, and what the environmental and social impacts of their recommended solution are is probably the joint responsibility of social studies and science education. Learning how to use secondary sources to gather further information on issues involves writing letters, using library/media reference systems, and using similar skills, thus providing an important role for language arts education. Collecting information from primary sources is within the realm of social studies education, if the information is being gathered from people, or science education, if technical in nature and collected directly from the environment. The interpretation of the collected data involves students in analysis by using graphs and other mathematical processes.

The ideal way to teach citizen action skills is to involve teaching staff members from different grade levels and at least those subject areas indicated above in planning and implementing the program. All three strategies—case studies, group issue investigation, and individual investigation—should be employed. Eventually each student should have an opportunity to complete at least one individual investigation of an issue, appropriate to the ability level of the student, and to plan for its resolution.

Figure 45

Comparison of Two Citizen Action Skill Instructional Strategies

Adapted with permission from "Changing Learner Behavior Through Environmental Education" by Harold R. Hungerford and Trudi L. Volk, *The Journal of Environmental Education* (Washington, DC: Heldref Publications) 21.3 (Spring 1990).

Characteristics	*Strategy*	
	Group Investigation	**Individual Investigation**
1. Appropriate grade	1-12	6-12
2. Group size	Usually entire class, smaller group possible	Individual
3. Student's role	Researcher in a large group	Autonomous investigator
4. Number of issues on which student gains in-depth knowledge	Usually one	Many
5. Sense of issue ownership gained	Moderate	Great
6. Citizen action skill development	Moderate	Very great
7. Student empowerment to act on a variety of issues	Small extent	Great extent
8. Anticipated student involvement in issue resolution outside of school	Moderate	Great
9. Issue focus	Single issue	Multiple issues
10. Teacher role	Initially traditional; facilitator during group investigation	Direct instruction on skills; facilitator of investigation/action
11. Demand for teacher flexibility	Moderate	High
12. Time requirement	9-18 weeks	About 18 weeks
13. Need for cooperation between subject area teachers	Moderate to great	Moderate to great
14. Need for inservice teacher education	High	Very high
15. Potential for infusion into existing programs	Very high	Moderate to high

Helping Students Gain Citizen Action Experience

Teaching citizen action skills to students, including the development of action plans, will do little for students or the environment if opportunities to implement such plans and attempts to resolve environmental issues are not provided. The discussion of the citizen action experience subgoal stressed the importance of providing students with opportunities to attempt the resolution of environmental issues in the real world, their own community. To teach for all the other subgoals of environmental education and not provide such experience is compared to teaching a driver's manual for the operation of an automobile but not providing behind-the-wheel instruction. Indeed, it is almost impossible to separate citizen action skill development and experiences in which such skills are applied.

Figure 25 (page 76) indicates that a major emphasis toward achieving the citizen action experience subgoal should wait until the senior high school grades, but this does not preclude some activity of this nature at earlier levels, even as early as kindergarten if the activity is at an appropriate level of sophistication for the students involved. It would be very appropriate for any elementary school teacher to incorporate teacher-guided citizen action experiences such as recycling paper and aluminum or participating in anti-litter campaigns in the school and its neighborhood into the instructional program.

At the middle school level, action plans resulting from group investigations of environmental issues should regularly be implemented with close guidance of the teacher. But it is also very important to allow individual students whom the teacher judges to be mature and adequately prepared to implement action plans they develop. There may be limitations on the kinds of action that can be taken by students of this age. These limitations are defined during the planning process and when the students evaluate the appropriateness of taking action using the criteria listed in section 3. Persuasive actions such as letter writing; consumer actions such as boycotting, conservation, or providing monetary support to organizations; and ecomanagement activities such as nature trail development or planting a school prairie are appropriate for middle school students.

Almost any type of action available to citizens is appropriate involvement for high school students. A senior high school student should have at least one opportunity to implement an action plan he or she has individually developed and several opportunities to implement cooperatively developed action plans before graduating from high school.

Real learning is participatory, experiential, and interdisciplinary, not just didactic. The flow can be two ways—between teachers who function best as facilitators, and students who are expected to be active agents in defining what is learned and how.
—David W. Orr

Dealing With Controversial Issues

In a free society there must be a citizenry that is not only capable of participating in the processes of that society that defend and enhance the quality of the universal environment, but one that is also motivated

Education's function is not to promote any propaganda, not to propound any principle as established and fixed for all time, not to assert that any belief is unchangeable, not to assert that any conclusion may not be mistaken—education's one and overwhelming responsibility is to establish the inquiring habit of mind and a veneration for truth.
—Ernest Martin Hopkins

to do so. Citizens who involve themselves in attempts to resolve environmental issues often become embroiled in controversy when significant differences in individual attitudes and values result in disagreement on the resolution of the issues. Such controversy is not only pervasive, but it is highly valued in a free society; it is a basic premise that different ideas and interests be allowed to compete. To be consistent with this premise, education in such a society must provide students with opportunities to confront alternative points of view, to weigh them rationally, to determine their own position on issues, and to decide on their own the courses of action they will follow in attempting to resolve issues.

This guide has attempted to describe how to develop a formal K-12 educational program that provides students with such opportunities. Educators involved in such a program have the task of providing the intellectual orientation and open atmosphere in which there can be intelligent confrontation. Educational experiences may then merge into the realities of citizenship, especially political decision making, rather than standing apart as a fragment of life in which the student patiently marks time while waiting for adulthood—the status of a person with the rights and responsibilities of citizenship. But in doing so educators must be careful to educate rather than indoctrinate. Educators have the right to be and often are environmentalists, citizens who advocate with action that wrongs against the environment must be stopped. But within the context of the classroom and the environmental education programs they must first be environmental educators, citizens who use information and educational processes to help students learn how to analyze the merits of the many and varied points of view usually present on a given environmental issue and to develop the skills needed to effectively participate in environmental decision making. They must be familiar with all sides of issues, stand firm for the right of each advocate to be heard, and provide a neutral atmosphere in which informed debate may take place (see Appendix I).

This does not mean that educators may never express their opinions on environmental issues. Indeed, it is almost impossible for them not to do so, if only by example, if they act on their personal convictions within their lives. But if educators are committed to programs like those described above, there is really little need for them to express their own point of view. They have the right to do so if they so desire, but it must be done in a manner that does not unduly influence the decision-making processes of their students. Perhaps the best time for educators to express their point of view is after an issue has been thoroughly examined and students have had an opportunity to determine their personal positions.

Educational Technology

Although direct experience is considered to be the most effective approach to teaching and learning about the environment, new and developing technologies that seem to have great potential for enriching instruction have emerged. This is especially true of videotapes, both passive and interactive, and computers.

Many excellent programs are telecast on both public and commercial networks. They are most often appropriate for students in upper elementary through senior high school grades. A variety of environmental topics are covered, some simply providing knowledge about specific elements of the environment or environmental issues, others seeking to stimulate thought and sometimes action on environmental issues. Many of these programs provide excellent vicarious experiences on topics for which a more direct experience is impossible. Educators are often allowed to tape and use the programs for instructional purposes within certain limits. Many also are available for rent or purchase.

Interactive video systems often provide students with opportunities to view material not available using other methodology by involving the student in using a computer and videodisc technology. The computer accesses information from a laser disk and displays it on a monitor. This technology also provides a supplement to environmental education, often providing material from the videodisc that is not easily available from any other source.

The use of computers greatly enhances instruction and learning about the environment. Software serving many different purposes is available and constantly being developed. Programs are available for

- drill and practice, the review and reinforcement of environmental concepts and/or skills already taught.
- tutoring, the introduction and explanation of environmental concepts and facts.
- simulations, models of the real world that allow students to make decisions and to interact in situations that are often too complex, expensive, dangerous, or distant to be brought into the classroom.
- discovery, opportunities to develop cognitive abilities in environmental problem solving.
- instructional gaming, activities that hold the learner's attention and interest while teaching logical thinking or making practice less tedious.
- word processing, the writing, editing, formatting, and printing of all kinds of written documents.
- databases, the collection, organization, retrieval, sorting, display, and printing of environmental data.
- spreadsheets, simulations of scientific worksheets where environmental data entered into cells can be calculated automatically.
- telecommunication, the input, transmission, sorting, receiving, and display of environmental information and messages from various sources.

The use of computers can make a significant contribution to the development and implementation of environmental education programs. They should not, however, replace direct experiences as the principal type of learning activity.

Facilities

If the premise is accepted that instructional activities for environmental education should be as direct as possible, which means that they

will often occur outside of the school building, there should be little need for major renovation of classrooms or other building facilities. There should be, however, adequate space in which to carry out indoor activities, prepare for all kinds of activities, and store materials and equipment. Flexible facilities that allow for a variety of kinds of activities are highly desirable.

The development of perceptual awareness therefore, can be affected by one's variety and quality of environmental experiences. An integral part of any environmental education program, therefore, is the development of opportunities for students to explore a wide variety of environments.
—James Swan

Facilities outside the classroom may need to be developed if they are to be most useful to the program. These may include the school campus, outdoor laboratories (such as forests, prairies, or marshes), parks, or even private land. The planning for and development of such sites is an excellent educational activity and should involve students, teaching and administrative staff members, and community representatives. It is also extremely important to identify community resources that might be used in the program. Water purification plants, sewage disposal plants, sanitary landfills, incinerators, local businesses and industries, governmental agencies, organizations, and people with expertise in some aspect of the environment should be listed and information on their potential contribution and how to contact them should be provided. A directory with this information should be updated annually.

Two other kinds of facilities may make a major contribution to environmental education programs. They are nature/environmental centers and resident camps. Most nature/environmental centers have highly qualified staff members who are willing to work with educators in planning and implementing programs and/or activities that correlate closely with classroom instruction at any level. Experiences at nature/environmental centers and residential camps make an important, unique contribution to environmental education, and their potential contribution to specific subgoals and objectives should be included in the school district's plan.

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The Purposes of Evaluation

Evaluation is a fundamental and continuing aspect of environmental education program planning and implementation. In general, evaluation is the means of determining program effectiveness—the degree to which students develop a perceptual awareness, acquire knowledge, develop a positive environmental ethic, acquire citizen action skills, and gain citizen action experience. It is also the means of determining the program's efficiency—how well chosen instructional strategies achieved desired results, the appropriateness of the settings in which the strategies were employed, and the adequacy of time and funding allocations. More specifically, evaluation can aid in the process of

- selecting, appraising, and clarifying goals, subgoals, and objectives;
- judging the intellectual integrity and sequence of the content of the curriculum;
- planning, directing, and improving instruction and/or learning experiences;
- determining what students have learned, both related to and apart from stated objectives;
- determining how students perceive, react to, and/or have been influenced by their experiences;
- assessing needs, problems, and opportunities within the area served by the program;
- helping to guide the planning and implementation of new programs;
- improving a program once it has been implemented or adopted;
- determining the acceptance of a program among all of those involved in the program;
- measuring a program against some set of criteria or standards, by some set of judgments, against a prior or alternative version of the program, or against a different program;
- determining the cost effectiveness of a program;
- selecting, appraising, and counseling instructional and support staff;
- selecting, appraising, and counseling resource people used in the program;
- advising, counseling, and reporting to school officials;
- identifying, planning for, and improving services to teachers and administrators, school buildings, and/or the entire school district;
- determining changes in public awareness of or views on environmental matters resulting from the activities of students;
- determining changes in environmental decisions and/or policies that may have resulted, in whole or in part, from the activities of students;
- determining changes in actual ecological and/or environmental conditions that were affected as a result of the activities of students.

Far too little consideration has been given to how program efforts have resulted in behaviors which promote wise use of resources, which encourage conservation, or which actually improve the environment.
—Ronald B. Childress and Jonathan Wert

Evaluation as a Continuous Activity

It is important to remember that evaluation should be a continuous activity, as shown in Figure 46, a part of every step in planning and

implementing a program. Figure 46 is a hybrid model adapted by Thomas Marcinkowski from several sources in environmental education literature. It portrays the basic relationships among testing, assessment, and evaluation activities and the important elements of program planning and implementation.

Needs Assessment: A needs assessment is used to identify and qualify current and/or projected needs of learners, teachers, the program, program supporters, and other entities served in and through a program.

Goals and Instructional Objectives: The goals, subgoals, and instructional objectives developed by the school district's environmental education and subject area committees are the heart of the curriculum. Goals and subgoals are based on identified needs of students. Instructional objectives stem from goals and subgoals and may be validated by using pretesting and assessment techniques.

Instructional Planning: There are three components of instructional planning: selecting learning theories and instructional designs, identifying and organizing content, and identifying learning resources and environments. Learning theory and research were discussed in section 4. Content was discussed in section 3, and its place in the curriculum was discussed in section 5. Learning resources and environments (facilities) were referred to in section 1 and discussed further in section 6. Pretesting can validate not only instructional objectives but all three components of instructional planning as well.

Instructional/Teaching Strategies and Learning Activities: Teaching strategies and learning activities were discussed in section 6. As they are being implemented in the classrooms or other learning environments, formative tests and assessments may yield results that suggest a need to modify one or more of the components of the instructional plan.

Learning Outcomes: Illustrative learning outcomes for each environmental education subgoal were provided in section 3. If the learning outcomes developed by the teaching staff working with the school district environmental education and subject area committees are tested, the results may suggest a need to modify any of the elements of the curriculum plan, from goals to instructional/teaching strategies and learning activities and environments.

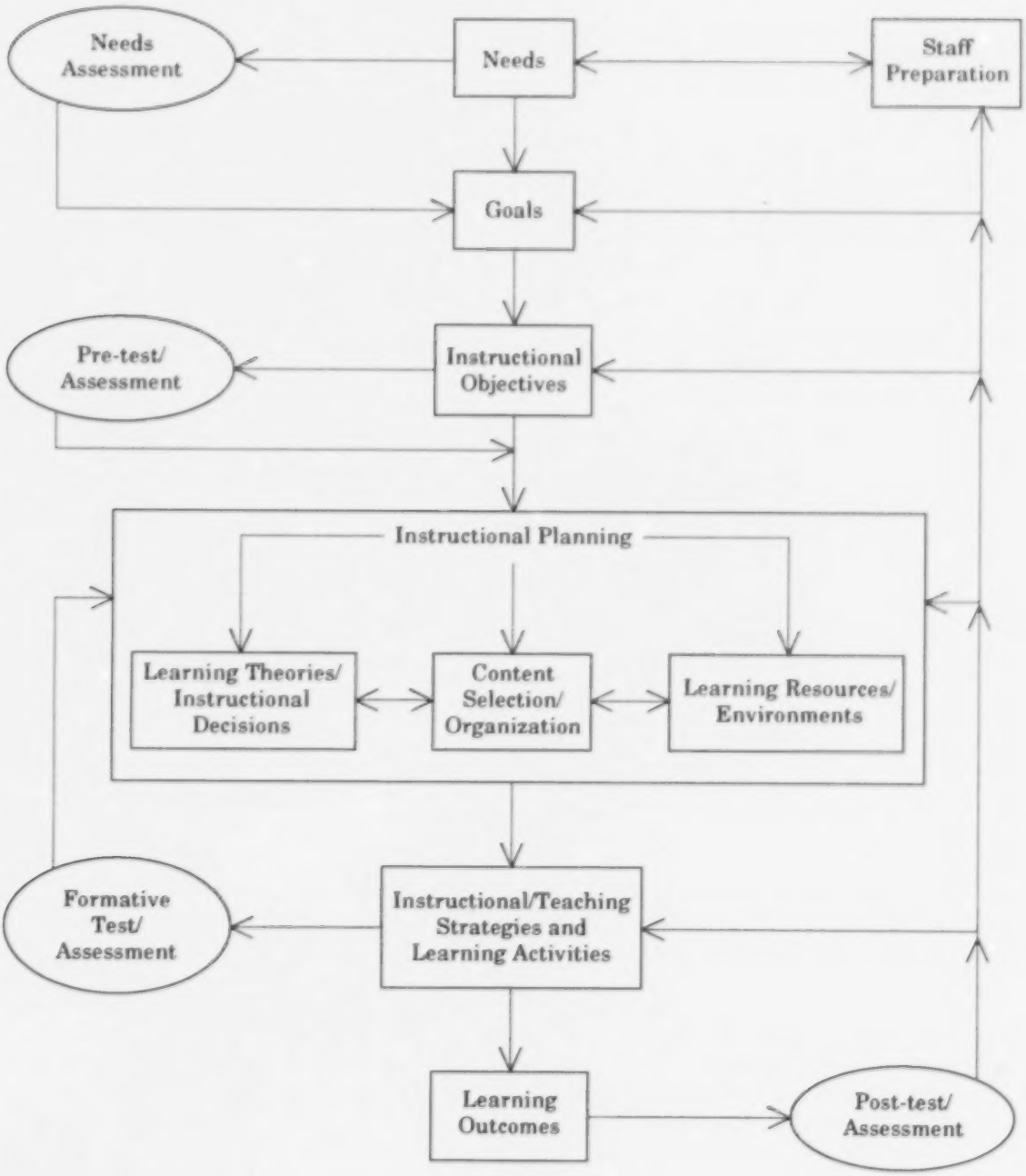
Staff Preparation: The need for staff preparation was discussed in section 1. Although it is the responsibility of the school district's environmental education committee to lead the development and implementation of the curriculum plan, it is likely to fail unless administrators and classroom teachers are part of the process. They should be consulted at every step of the planning process and educated about the goals, instructional objectives, and the instructional plan. They must be actively involved in selecting and developing instructional/teaching strategies and learning activities, with assistance from the environmental education committee. The district staff, if they are to be involved in these ways, must receive special preparation as described in section 1.

. . . An approach to evaluation which actively or passively conceals the complex personal, political, context-dependent (and often idiosyncratic) nature of an educational form like [environmental education], and treats it as a purely technical process susceptible to the instrumental testing of intention / outcome fidelity, not only obscures its authentic character but serves to reinforce the very institutional, political constraints which to date have undermined its improvement.
—Ian Robottom

Figure 46

The Role of Evaluation in Program Planning and Implementation

Adapted with permission from "Assessment in Environmental Education" by Tom Marcinkowski, *Environmental Education Teacher Resource Handbook*, Kraus International Publications, 1993.



It is beyond the scope of this guide to provide a detailed discussion of the whole array of evaluation methods. The UNESCO publication by Dean B. Bennett, *Evaluating Environmental Education in Schools: Environmental Education Series 12*, provides an excellent discussion of these methods and relates them to environmental education. To obtain a copy of Bennett's book, send the request on institutional letterhead to UNESCO, 7, Place de Fontenoy, 75700 Paris, France.

An excellent complement to Bennett's book is the paper by Thomas Marcinkowski, "Assessment in Environmental Education," which appears in *Environmental Education Teacher Resource Handbook*. It is strongly suggested that both publications be obtained and used by a school district committee prior to developing, implementing, and evaluating a curriculum plan and program.

Using the Results

The preparation of an evaluation report is an essential activity in the evaluation process. A report can be used to

- inform interested parties of program strengths, weaknesses, and overall quality;
- demonstrate a measure of accountability;
- generate confidence in the program;
- solicit support;
- organize information for program improvement purposes; and
- provide feedback to all participants, especially students.

There are many potential audiences for an evaluation report, including the school board, school administrators, other teachers, students, parents, interested citizens, educational and other public agencies, funding organizations, and media. The same report may not be appropriate for each of these audiences. Press releases may suffice for some, a more technical report may be useful to others. Some of these audiences may be interested in progress reports during the implementation of the program, all should be interested in the contents of a final report which, hopefully, will lead to action to improve the program.

A final report should include the following information:

- a purpose: summarize results, draw conclusions, make recommendations;
- an abstract: a concise summary of major findings, conclusions, recommendations;
- a program rationale: reasons for the program, stated in terms of the needs of students, the target audience;
- a goal and objectives: changes expected in students as a result of the program activities;
- activities: what was done, who participated, when each major activity took place;
- an evaluation design: purposes, instruments, procedures, people involved;

. . . Educational evaluation is a systematic and formal process of gathering information. . . . This information is used to assess the merit or judge the worth of educational phenomena. This includes all aspects of the educational process and resulting products such as goals and objectives.
—Dean Bennett

- evaluation results: changes in student perceptual awareness; knowledge; environmental ethic; citizen action skills; and citizen action experience. Also, the impacts on the environment; marginal and/or unclear results; unexpected positive and negative outcomes;
- conclusions: the extent to which each goal was met; significance of unexpected outcomes; the quality of the rationale, goals, and objectives; the value of the program activities; the contribution of the program to societal and educational needs; the cost-effectiveness of the program;
- recommendations: needed program changes arranged in order of priority; a proposed timeline for implementation; resources and other elements of support needed to implement the changes.

The final report should be officially submitted to and accepted by the school board, in most instances through the district administrator. These officials are responsible for approving the report and its recommendations and for identifying sources of funding and other resources needed to implement them. When this has been accomplished, the task of improving the program can begin.

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Appendix A

Wisconsin Curriculum Planning Requirement

Wisconsin Administrative Code PI 8.01(2)(k). *Curriculum Plan.* 1. In this paragraph:

a. "Computer literacy" means the ability to use computer programs to assist learning, handling information and problem solving, and the ability to make informed judgments concerning social and ethical issues involving computers and information systems.

b. "School district curriculum plan" means the composite of the sequential curriculum plans.

c. "Sequential curriculum plan" means an organized set of learning experiences that build upon previously acquired knowledge and skills.

2. Each school district board shall develop, adopt and implement a written school district curriculum plan which includes the following:

a. A kindergarten through grade 12 sequential curriculum plan in each of the following subject areas: reading, language arts, mathematics, social studies, science, health, computer literacy, environmental education, physical education, art and music.

b. A grade 7 through 12 sequential curriculum plan in vocational education.

3. Each sequential curriculum plan shall specify objectives, course sequence, course content, resources, an objective process of determining whether pupils attain the specified objectives, and an allocation of instructional time by week, semester and school term. The school district board shall establish in the school district curriculum plan the allocation of instructional time, by week, semester and school term, among all subject areas.

4. Each sequential curriculum plan shall include a program evaluation method which provides that components of the sequential curriculum plan shall be monitored continuously. The overall program evaluation method shall be reviewed at least once every 5 years and revised as appropriate to ensure that pupils meet the curriculum objectives.

5. The school district curriculum plan shall be consistent with the approved education for employment program under ch. PI 26.

6. The school district board shall develop sequential curriculum plans in at least 3 of the subject areas specified in subd. 2 by September 1, 1988; in at least 3 more of the subject areas specified in subd. 2 by September 1, 1989; and in all of the remaining subject areas specified in subd. 2 by September 1, 1990. The computer literacy and environmental education curriculum plans shall be developed as follows:

a. Computer literacy objectives and activities shall be integrated into the kindergarten through grade 12 sequential curriculum plans.

b. Environmental education objectives and activities shall be integrated into the kindergarten through grade 12 sequential curriculum plans, with the greatest emphasis in art, health, science and social studies education.

Wisconsin Environmental Education Act of 1990

The Wisconsin Environmental Education Board

The Wisconsin Environmental Education Board (WEEB) was established when Governor Thompson signed Legislative Act 299 in April 1990. The 15-member board represents various constituencies, including the legislature, state agencies, business and labor, higher education, agriculture, K-12 schools, nature and environmental centers, and conservation/environmental organizations. The legislation charged WEEB with identifying needs and establishing priorities for environmental education in Wisconsin.

The Wisconsin Environmental Education Act also created an annual matching grants program, which is administered by WEEB, that makes available $200,000 annually for matching grants. Eligible grant applicants include corporations (including non-stock, non-profit corporations) and public agencies (including counties, villages, cities, towns, public inland lake protection and rehabilitation districts, school districts, and cooperative educational service agencies).

For further information on WEEB and the environmental education grants program contact:

Wisconsin Environmental Education Board
P.O. Box 7841
Madison, WI 53707-7841
(608) 266-3155

The Wisconsin Center for Environmental Education

Established as part of the University of Wisconsin-Stevens Point College of Natural Resources by Legislative Act 299 in 1990, the Wisconsin Center for Environmental Education (WCEE) was created to promote the development, dissemination, implementation, and evaluation of environmental education programs for elementary and secondary school teachers and students in Wisconsin. Following are brief descriptions of some of the major programs and projects the WCEE is pursuing.

Environmental Education Network. The Wisconsin School System Environmental Education Network, coordinated by the WCEE, was established in 1991. This information network is made available through the efforts of a consortium represented by the DPI, Department of Natural Resources, Wisconsin Association of Environmental Education, UW-Cooperative Extension, and the WCEE. By joining the network, schools receive quarterly mailings that include environmental education newsletters; resource bibliographies; announcements of conferences, workshops, and courses; environmental education grant and awards information; and lists of resource people. Teacher liaisons reported in a recent survey that school membership in the network has improved communication between teachers and state environmental education organizations and agencies, provided timely environmental education information, improved dissemination of environmental education information to teachers, raised awareness and interest in teaching environmental education, and saved time for busy teachers by providing materials that would be difficult to acquire otherwise.

Environmental Education Library. A major focus of the WCEE has been to establish an environmental education resource library for elementary, middle, and secondary school teachers. Materials available for examination at the center include environmental education curriculum and activity guides, trade books, reference books, magazines, videotapes, games, and computer software. Information about these resources is also distributed through the Environmental Education Network.

Outreach Courses. In 1990, the WCEE began a cooperative project with the National Science Foundation to provide environmental education courses to Wisconsin school teachers and administrators. More than 25 outreach instructors from throughout the state developed and now offer the following environmental education courses: principles of environmental education, ecological foundations of environmental education, citizen action in environmental education, and environmental education teaching strategies.

Assessment. In cooperation with the DPI, staff members of the WCEE are developing instruments and methods to be used to assess the environmental literacy of Wisconsin's students as well as teacher competencies in environmental education. To assist with this project, an advisory committee made up of teachers, school administrators, environmental education professionals, and testing experts was established. Additionally, a panel of educators worked with staff members to develop test items for the assessments.

The WCEE, in cooperation with DPI and the cooperative educational service agencies (CESAs), also is charged with assisting school districts in conducting environmental education needs assessments.

For further information about WCEE, write:
Wisconsin Center for Environmental Education
Learning Resources Center
UW-Stevens Point
Stevens Point, WI 54481

Wisconsin Teacher Certification Rule

Wisconsin Administrative Code PI 3.05(4) ENVIRONMENTAL EDUCATION EFFECTIVE JULY 1, 1985. Adequate preparation in conservation of natural resources is required for a license to teach agriculture; early childhood, elementary, and elementary/middle level education; and for middle, middle/secondary, and secondary level education licenses in science and social science, except psychology. An applicant who completed an initial professional education program for these licenses on or after July 1, 1985, shall have completed an approved program which provides students with all of the following:

(a) Knowledge of the wide variety of natural resources and methods of conserving these natural resources.

(b) Knowledge of interactions between the living and non-living elements of the natural environment.

(c) Knowledge of the concept of energy and its various transformations in physical and biological systems.

(d) Knowledge of local, national, and global interactions among people and the natural and built environments including all of the following:

1. Historic and philosophical review of the interactions between people and the environment.
2. The social, economic, and political implications of continued growth of the human population.
3. The concept of renewable and non-renewable resources and the principles of resource management.
4. The impact of technology on the environment.
5. The manner in which physical and mental well-being are affected by interaction among people and their environments.

(e) Ability to use affective education methods to examine attitudes and values inherent in environmental problems.

(f) Ability to incorporate the study of environmental problems in whatever subjects or grade level programs the teacher is licensed to teach through the use of all the following methodologies:

1. Outdoor teaching strategies.
2. Simulation.
3. Case studies.
4. Community resource use.
5. Environmental issue investigation, evaluation, and action planning.

(g) Knowledge of ways in which citizens can actively participate in the resolution of environmental problems.

Appendix D

Equity and Multicultural Considerations in Environmental Education

Factors such as sex, race, color, ethnicity, and physical and mental abilities are often used to sort, group, and track students into stereotyped patterns that prevent the exploration of all options and opportunities in which individuals may have talent or interest. Such treatment has a significant cost in terms of the individual's academic achievement, psychological and physical development, career choice, and family relationships. Each student should have opportunities to be challenged, to grow and develop, and to achieve identity limited only by his or her talents.

In the development and implementation of environmental education programs and in the selection of materials, all students should be able to see that people of all races, genders, religions, ages, and ethnicities have contributed to the field of environmental education. Six forms of bias should be eliminated.

Invisibility. Underrepresentation of certain groups. This leads to the implication that these groups are of less value, importance, and significance.

Stereotyping. Assigning traditional and rigid roles or attributes to a group. This limits the abilities and potential of the group and denies students knowledge of the diversity, complexity, and variations of that group.

Imbalance/selectivity. Presenting only one interpretation of an issue, situation, or group. This distorts reality and ignores complex and differing viewpoints through selective presentation of materials.

Unreality. Presenting an unrealistic portrayal of history and of contemporary life experience.

Fragmentation/isolation. Separating issues related to minorities and women from the main body of the text.

Language bias. Excluding the role and importance of females by constant use of the generic "he" and other sex-biased words; and devaluing certain races by associating certain colors with negative attributes (for example, black hats, black thoughts).

Wisconsin school districts are urged to actively promote the value of all persons by including the contributions, images, and experiences of all groups in the development of environmental education curricular objectives and classroom activities.

A Planning Checklist for a School District Environmental Education Program

Directions

This checklist may be used to determine to what degree existing environmental education programs possess the characteristics within each category. The use of a scale from 1 (very poor) to 5 (excellent) is suggested. The checklist also may be used to guide a school district environmental education committee as it plans and implements the development of a program.

Very poor	Poor	Good	Very good	Excellent
1	2	3	4	5

A. Philosophy and policy: The district has written statements of its philosophy of environmental education and of its official policy regarding the implementation of that philosophy.
   1. The environmental education statements of philosophy and policy were developed by a committee with a membership representing the administration (all levels), teaching staff (all levels and subject areas), school board, students (all levels), parents, and other community citizens.
   2. The chairperson of the environmental education committee is assigned continuing authority and responsibility to direct and assist in the implementation of the environmental education philosophy, policy, curriculum plan, and instructional program.
   3. The environmental education philosophy is consistent with the district's overall philosophy of education.
   4. The environmental education philosophy is consistent with the current state environmental education guidelines.
   5. The school board has officially approved the district's environmental education philosophy statement.
   6. The school board has officially approved the policy statement regarding the implementation of the environmental education philosophy.

B. Curriculum plan: The district has a written, sequential curriculum plan for environmental education based on the known developmental needs and characteristics of students.
   1. The plan includes a goal statement dealing with preparing citizens to work effectively in maintaining and enhancing environmental quality.
   2. The goal statement identifies the development of perceptual awareness, the acquisition of knowledge, the development of a positive environmental ethic, the development of citizen action skills, and the acquisition of citizen action experience as subgoals and categories of desirable learner outcomes.
   3. The plan uses the known developmental characteristics of students as the basis for determining when instruction toward each subgoal should receive its greatest emphasis, namely:

- perceptual awareness in grades K-3;
- knowledge in grades 3-9;
- citizen action skills in grades 6-12;
- citizen action experience in grades 9-12; and
- environmental ethic in grades K-12.

4. The plan includes an environmental education curriculum framework, based on these five subgoals and categories of desirable learner outcomes.
5. The curriculum framework includes all aspects of the environment—natural, built, technological, and social (including economic, political, cultural, moral, and aesthetic).
6. The curriculum framework identifies the potential contribution of each subject with every subject area included, but emphasizes the major contributions expected of art, communication arts, family and consumer living, health, science, social studies, and technology education.
7. The curriculum framework is cross-referenced with the curriculum frameworks of all subject area curriculum plans and emphasizes the simultaneous achievement of subject area and environmental education objectives.

C. Instructional program: The basis for selecting instructional approaches is the age and maturity of the learner.

1. Instructional activities are selected or developed by classroom teachers responsible for a given section of the curriculum framework, with assistance from the environmental education committee.
2. The degree of concreteness or abstractness of the type of learning experience is considered when selecting instructional approaches:

Concrete	Direct Experiences
|	Contrived experiences
|	Dramatizations
|	Demonstrations
|	Computer simulations
|	Displays, exhibits, models
|	Motion pictures, videotapes
|	Recordings, radio, charts, still pictures
|	Visual symbols
Abstract	Verbal symbols

3. Most of the experiences chosen for learners in grades K-3 are very concrete.
4. Many of the experiences chosen for learners in grades 3-6 are very concrete; many are somewhat more abstract.
5. Many of the experiences chosen for learners in grades 6-9 are abstract; but concrete experiences remain important and are chosen as often as possible.
6. Many of the experiences chosen for learners in grades 9-12 are abstract; but concrete experiences remain important and are chosen as often as possible.
7. Affective outcomes are rarely taught for in isolation, being an important part of every learning experience, with a very high emphasis in grades K-2 that decreases as the learner progresses through grade 12.

D. Learning environments: Various learning environments are used in implementing the instructional program.

1. The classroom serves as the primary base of operations, but many instructional activities are conducted in other places, such as the school building; the school

site; the school neighborhood; privately owned facilities, such as stores, farms, and forests; publicly owned facilities, such as wastewater treatment plants and wildlife areas; nature/environmental day and/or residential centers; museums; and zoos.

2. The learning environment in which an instructional activity is conducted is chosen because it is the ideal environment for learners to gain the intended outcomes of the activity.
3. The school district policy allows teachers to use an extraclassroom learning environment for an instructional activity when the use of the learning environment best fits into the sequence of the instructional program.

E. Staff preparation: Administrative and teaching staff members have received instruction in environmental education to help them fulfill their responsibilities to the program.

1. The members of the school district environmental education committee have received special instruction in environmental education to help them fully understand its nature and its place in the total curriculum in order for them to lead in the development and implementation of the district plan and program.
2. Administrative and teaching staff members have received instruction dealing with the school district's philosophy and policy statements; the goal/subgoal with which they will work; and the processes for identifying the environmental content of their subject area.
3. Administrative and teaching staff members have been provided opportunities to meet a minimum level of understanding of environmental education as described by Wisconsin Administrative Code PI 3.05(4).

F. Assessment and evaluation: Procedures for determining the effectiveness and efficiency of the program have been developed and implemented.

1. The procedures are designed to make assessment and evaluation a continuing activity at every stage of program development and implementation.
2. Although the development and implementation of the evaluation process is a responsibility of the district environmental education committee, those who are directly affected by the evaluation (students, classroom teachers) and those who will use the findings (classroom teachers, administrators, school board members) are actively involved in planning and implementing the process.
3. The district environmental education committee prepares an annual report on the effectiveness and efficiency of the program. The report is submitted to the district administrator and the school board. The report serves as a basis for identifying program needs and planning for further development of the program.
4. The district environmental education committee periodically plans, implements, and reports on the evaluation of special aspects of the program.

G. Budgetary considerations: Sufficient funds to plan and implement the program are provided.

1. Members of the district environmental education committee are adequately remunerated for the extra time they devote to the planning and implementation of the program.
2. The chairperson of the district environmental education committee is remunerated for the extra time involved in leading the planning and implementation of the program and/or is provided with release time in which to do so.

3. Funds are provided to cover the costs involved in planning and implementing the program, including those needed by the district environmental education committee to complete its assignments; those needed to purchase supplies and equipment needed to effectively implement the program; those needed for transportation to learning environments that are beyond walking distance; those for user fees for museums, nature/environmental education centers, and so forth; and those needed to reimburse any staff member for participating in summer planning sessions, inservice training sessions, workshops, and professional conferences.

The Tbilisi Declaration

The world's first intergovernmental conference on environmental education was organized by the United Nations Education, Scientific, and Cultural Organization (UNESCO) in cooperation with the U.N. Environment Programme (UNEP) and was convened in Tbilisi, Georgia (USSR) from October 14-26, 1977.

Delegates from 66 member states and observers from two nonmember states participated. Representatives and observers from eight U.N. agencies and programs also participated. Three other intergovernmental organizations and 20 international nongovernmental organizations also were represented. In all, 265 delegates and 65 representatives and observers took part in the conference.

The Tbilisi Declaration was adopted by acclamation at the close of the intergovernmental conference. The declaration noted the unanimous accord in the important role of environmental education in the preservation and improvement of the world's environment, as well as in the sound and balanced development of the world's communities.

The Role, Objectives, and Characteristics of Environmental Education

The Tbilisi Declaration together with two of the recommendations of the Conference constitutes the framework, principles, and guidelines for environmental education at all levels—local, national, regional, and international—and for all age groups both inside and outside the formal school system.

I. The Conference *recommends* the adoption of certain criteria which will help to guide efforts to develop environmental education at the national, regional, and global levels:

- Whereas it is a fact that biological and physical features constitute the natural basis of the human environment, its ethical, social, cultural, and economic dimensions also play their part in determining the lines of approach and the instruments whereby people may understand and make better use of natural resources in satisfying their needs.
- Environmental education is the result of the reorientation and dovetailing of different disciplines and educational experiences which facilitate an integrated perception of the problems of the environment, enabling more rational actions capable of meeting social needs to be taken.
- A basic aim of environmental education is to succeed in making individuals and communities understand the complex nature of the natural and the built environments resulting from the interaction of their biological, physical, social, economic, and cultural aspects, and acquire the knowledge, values, attitudes, and practical skills to participate in a responsible and effective way in anticipating and solving environmental problems, and in the management of the quality of the environment.
- A further basic aim of environmental education is clearly to show the economic, political, and ecological interdependence of the modern world, in which decisions and actions by different countries can have international repercussions. Environmental education should, in this regard, help to develop a sense of responsibility and solidarity

among countries and regions as the foundation for a new international order which will guarantee the conservation and improvement of the environment.

- Special attention should be paid to understanding the complex relations between socio-economic development and the improvement of the environment.
- For this purpose, environmental education should provide the necessary knowledge for interpretation of the complex phenomena that shape the environment, encourage those ethical, economic, and esthetic values which, constituting the basis of self-discipline, will further the development of conduct compatible with the preservation and improvement of the environment. It should also provide a wide range of practical skills required in the devising and application of effective solutions to environmental problems.
- To carry out these tasks, environmental education should bring about a closer link between educational processes and real life, building its activities around the environmental problems that are faced by particular communities and focusing analysis on these by means of an interdisciplinary, comprehensive approach which will permit a proper understanding of environmental problems.
- Environmental education should cater to all ages and socio-professional groups in the population. It should be addressed to (a) the general nonspecialist public of young people and adults whose daily conduct has a decisive influence on the preservation and improvement of the environment; (b) to particular social groups whose professional activities affect the quality of the environment; and (c) to scientists and technicians whose specialized research and work will lay the foundations of knowledge on which education, training, and efficient management of the environment should be based.
- To achieve the effective development of environmental education, full advantage must be taken of all public and private facilities available to society for the education of the population: the formal education system, different forms of nonformal education, and the mass media.
- To make an effective contribution towards improving the environment, educational action must be linked with legislation, policies, measures of control, and the decisions that governments may adopt in relation to the human environment.

II. The Conference *endorses* the following goals, objectives, and guiding principles for environmental education:

The *goals* of environmental education are:

- to foster clear awareness of, and concern about, economic, social, political, and ecological interdependence in urban and rural areas;
- to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment;
- to create new patterns of behavior of individuals, groups, and society as a whole towards the environment.

The categories of environmental education *objectives* are:

Awareness—to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems.

Knowledge—to help social groups and individuals gain a variety of experience in, and acquire a basic understanding of, the environment and its associated problems.

Attitudes—to help social groups and individuals acquire a set of values and feelings of concern for the environment and the motivation for actively participating in environmental improvement and protection.

Skills—to help social groups and individuals acquire the skills for identifying and solving environmental problems.

Participation—to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems.

Guiding principles—environmental education should

- consider the environment in its totality—natural and built, technological and social (economic, political, cultural-historical, ethical, esthetic);
- be a continuous lifelong process, beginning at the preschool level and continuing through all formal and nonformal stages;
- be interdisciplinary in its approach, drawing on the specific content of each discipline in making possible a holistic and balanced perspective;
- examine major environmental issues from local, national, regional, and international points of view so that students receive insights into environmental conditions in other geographical areas;
- focus on current and potential environmental situations while taking into account the historical perspective;
- promote the value and necessity of local, national, and international cooperation in the prevention and solution of environmental problems;
- explicitly consider environmental aspects in plans for development and growth;
- enable learners to have a role in planning their learning experiences and provide an opportunity for making decisions and accepting their consequences;
- relate environmental sensitivity, knowledge, problem-solving skills, and values clarification to every age, but with special emphasis on environmental sensitivity to the learner's own community in early years;
- help learners discover the symptoms and real causes of environmental problems;
- emphasize the complexity of environmental problems and thus the need to develop critical thinking and problem-solving skills;
- utilize diverse learning environments and a broad array of educational approaches to teaching, learning about and from the environment with due stress on practical activities and first-hand experience.

Appendix G

Characteristics of Children and the Implications for Environmental Education*

Children in the lower elementary grades	Implications for environmental education
1. . . . are curious and employ all their senses in exploring their surroundings.	1. Activities should promote touching, hearing, seeing, and smelling as ways for gathering information about their environments.
2. . . . bring to school a wide variety of cognitive abilities.	2. Activities that offer children of differing cognitive abilities the opportunity to participate and succeed should be developed.
3. . . . are limited in their ability to interpret time, space, and distance.	3. Activities should minimize time, space, and distance aspects of the environment.
4. . . . have difficulty in realizing that objects have several properties.	4. Activities should emphasize objects with a relatively small number of properties.
5. . . . have difficulty thinking logically.	5. Activities requiring logical development of relationships should be minimized, particularly in the early grades.
6. . . . begin reasoning simple cause and effect relationships.	6. Activities should promote the examination of simple cause and effect relationships in the environment.
7. . . . like immediate results and lose interest in prolonged experiences.	7. Activities should be varied, brief, and scaled to the attention span of the children.
8. . . . seek out identification and clarification of their individual roles as people.	8. Activities should include experiences aimed at answering the question, "Who am I?" in relation to their environment.
9. . . . are limited in the complexity and variety of their communication skills.	9. Activities should assist children in expanding and strengthening their use of verbal and nonverbal communication skills.
10. . . . are capable of recognizing the mood of a speaker as factual, serious, or humorous.	10. This suggests the importance of the teacher's interest, sincerity, and concern while speaking with the children about the environment.

* Based on a statement in *Environmental Education Guide K-12*, State Department of Education, Richmond, Virginia, July 1974. A similar statement may be found in Kelly, Joseph R., and Edwin P. White. "A Developmental Framework For Planning Environmental Education Programs." *Science and Children* (April 1975).

11. . . . enjoy pictures and read their own experience into them as they talk about what they see.	11. Careful selection of pictures by the teacher can promote interest in the environment and foster the consideration of simple relationships.
12. . . . enjoy using various art forms and media as means of expressing their ideas and feelings.	12. The children's use of art forms and media can provide valuable information concerning the children's knowledge of, and attitudes toward, their environment.
13. . . . enjoy sharing their experiences with others in their class.	13. Discussion and guided questioning by the teacher may promote understanding of environmental phenomena as they relate to the children's experience.
14. . . . enjoy listening to stories read to them.	14. By carefully selecting stories to be read, teachers can help children become interested in various aspects of their environment.
15. . . . enjoy collecting objects from nature and technology.	15. Interests revealed by the children's collections may serve as a focus for planned environmental experiences.
16. . . . have limited psychomotor coordination, dexterity, and stamina.	16. Activities that do not make unrealistic demands on the children's psychomotor capabilities and endurance should be selected.
17. . . . possess a rudimentary moral sense based on highly personal concepts of right and wrong.	17. Activities that avoid complex value dilemmas related to externally based moral systems should be chosen.
Children in the middle elementary grades begin to	**Implications for environmental education**
1. . . . have difficulty initially in isolating variables and often proceed from step to step in thinking without relating each link to all others.	1. Early in this period, activities should involve small numbers of variables and minimal emphasis on logical relationships.
2. . . . distinguish between observations and inferences.	2. Activities should promote the distinction between observing and inferring and the logical basis for the process of inferring.
3. . . . distinguish between fact and opinion.	3. Activities should promote the distinction between fact and opinion and their relative worth as a basis for decision making.
4. . . . develop special interests and hobbies.	4. Activities should offer children the opportunity to pursue their individual interests.

5. . . . understand the relationship between cause and effect.	5. Activities should present situations in which cause-effect relationships may be examined.
6. . . . have increased and refined psychomotor skills.	6. Activities that require increased psychomotor coordination may be developed.
7. . . . show increasing concern for the authenticity of materials that they read.	7. With the teacher's assistance, children may be helped to question the authenticity of readings about the environment.
8. . . . detect more subtle forms of a speaker's intent: informative, persuasive, evasive.	8. The degree of interest, enthusiasm, and commitment that the teacher possesses in relation to environmental issues becomes increasingly evident to the children.
9. . . . become increasingly involved as a personal commitment is made.	9. Activities should stress an action orientation that will result in a stronger commitment to the improvement of the children's environment.
10. . . . become more capable and desirous of involvement in making decisions.	10. Activities should involve children in making decisions about themselves and their environment.
11. . . . function as part of a group and begin to understand social requirements and social responsibility.	11. Activities should foster group experiences and promote the idea that the actions of individuals affect groups and that the individual has a responsibility to the group.
12. . . . relate vicariously to people and places through literature.	12. Learning about other environments through use of carefully selected literature may help children examine their own environments more critically.
13. . . . develop moral reasoning based on viewing life from other points of view than their own.	13. Activities can provide opportunities for making moral decisions on a basis other than what is right or wrong for one as an individual.
Children in the upper elementary grades begin to	**Implications for environmental education**
1. . . . handle two or more variables with ease and comprehend logical relationships.	1. Activities may deal with several variables and promote the search for logical relationships.
2. . . . make predictions based on past experiences.	2. Activities that emphasize predicting may be developed.

3. . . . develop the capability to hypothesize and develop simple tests of hypotheses.	3. Activities should promote the formulation of hypotheses based on data and the development of means for testing them.
4. . . . develop the ability to discriminate, clarify, and challenge experiences.	4. Activities should promote the identification of significant factors in a complex environmental setting and promote the clarification of environmental issues.
5. . . . see discussion as a way of working toward group decisions and the resolution of issues.	5. Activities may be developed around more complex issues to be resolved through group processes.
6. . . . become capable of understanding decision-making processes and the resulting implications of making decisions.	6. Activities should provide opportunities for children to make decisions and be responsible for the resulting consequences.
7. . . . need the opportunity to assume responsibility in order to learn the relationship between choice and responsibility.	7. Activities should promote choice and decision-making in a context of responsible action.
8. . . . feel an emotional attachment toward their country and begin developing enduring patriotism.	8. Activities to encourage feelings of responsibility by the individual toward the betterment of his or her country may be developed.
9. . . . examine and question established belief systems.	9. Activities that raise questions about belief systems and allow the examination of the foundational beliefs on which such systems are based may be developed.
10. . . . comprehend moral reasoning based on what is best for society, the greatest number, or the social order.	10. Activities that promote more complex moral judgments about environmental issues may be developed.

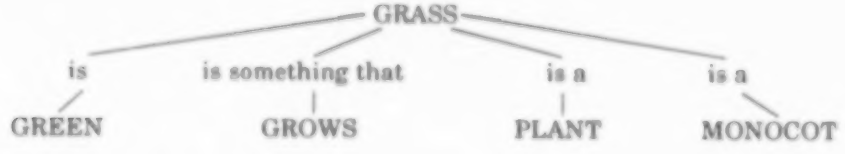
Appendix H

Concept Mapping

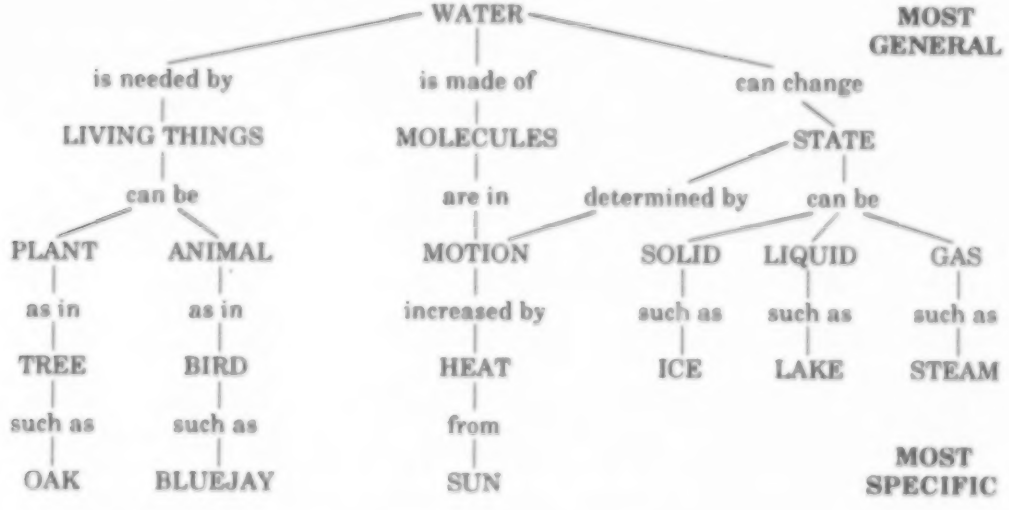
The construction of knowledge begins with observation of objects or events. An object is anything that exists and can be observed, such as a sandhill crane, a star, a house, or a cloud. An event is anything that happens or can be made to happen, such as lightning, schooling, a wedding, or a flood. Concepts are objects or events that show a regularity. Concepts are given labels for the purpose of communication. For example, wind is air in motion, and a chair has legs, a back, and a seat. Children acquire concepts through their culture; schools are cultural devices that (theoretically) accelerate the process.

Most concepts are learned through a composite of propositions, two or more concept labels linked by words in a semantic unit such as "The sky is blue." A concept label is given more precise meaning when multiple propositions include the concept. For example, the proposition "Grass is green" provides a very limited understanding of the concept grass. "Grass is something that grows" expands on that understanding, "Grass is a plant" provides an even greater understanding, and "Grass is a monocot" even more.

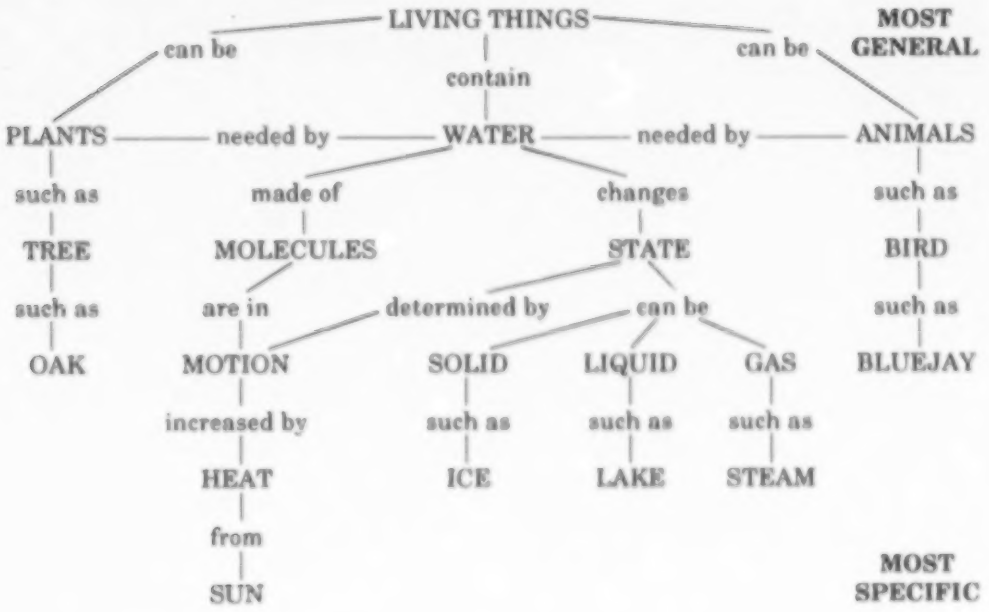
A concept map is a schematic device for representing a set of concept labels embedded in a framework of propositions. The set of concepts in the examples above can be represented as follows.

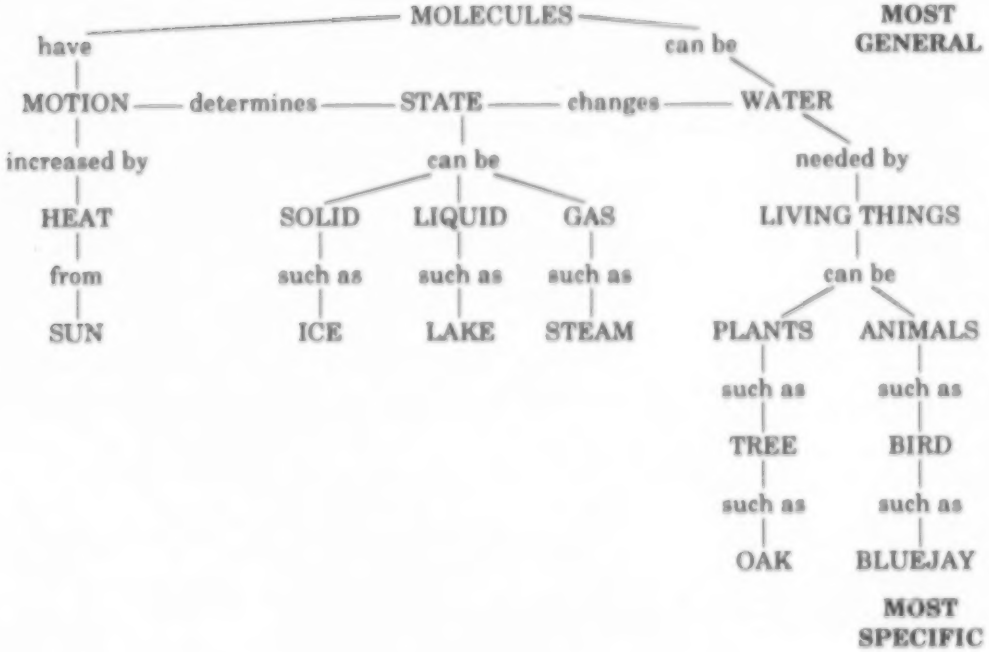


Meaningful learning proceeds most easily when new concepts or concept meanings are subsumed under broader, more inclusive concepts. Thus concept maps are hierarchical, with the more inclusive concept at the top of the map, and progressively more specific concepts arranged below them. A concept map for water illustrates this point.



The same concepts can be mapped in other ways.





Rearranging concepts in this fashion is what one does in reflective thinking. Constructing concept maps, especially if multiple arrangements are made, often results in the recognition of new relationships. Concept mapping, however, is only a technique for externalizing concepts and propositions, and may not accurately represent the concepts an individual actually possesses or the range of relationships between concepts that an individual knows and can express as propositions.

Concept mapping may be used

- as a planning technique, clarifying for teachers and students the key ideas on which they must focus for a specific learning task;
- as a visual "road map" showing possible instructional pathways to follow in instruction and learning; and
- as a technique to determine how well a student understands the concepts included in a specific learning task.

Two Hats*

It would appear that environmental educators have a bad case of the "two hat" problem. We have come by the problem naturally and therefore, we have paid little attention to it.

The problem is simply that industry, utilities, labor, business, media, and other segments of the population and the general public have consistently recognized only one hat when talking about environmentalists and environmental educators. It is not uncommon for dedicated environmental educators to be summarily dismissed as trouble-makers—environmentalists. This one-hat view is easily explained because environmental educators are almost always environmentalists. Perhaps definitions will help clarify the problem.

Any world citizen who advocates with greater or lesser action that wrongs against our environment must be stopped is an environmentalist. Perhaps the negative reputation environmentalists have stems from the dramatic and radical actions of a few.

An environmental educator, on the other hand, is any world citizen who uses information and educational processes to help people analyze the merits of the many and varied points of view usually present on a given environmental issue. The environmental educator is not the "mediator," "trade-off specialist," or "negotiator," but a developer of skills and an information analyst who prepares the people (from any segment of the population) who will participate in environmental decision making.

Environmental educators, therefore, need to be as "value fair" or "value free" as they can when working in this role. They must scrupulously strive to get all the facts, examine and illuminate all the viewpoints, and keep from letting their own particular position (as an environmentalist) from mixing with their educator role.

My suggestion is simply that environmental educators make an effort to clarify the two distinct roles. At every opportunity, we should emphasize the neutral nature of environmental education activity. Strong advocacies are all around us, each using the techniques of persuasion and propaganda to build their constituencies. We must ourselves be familiar with all sides, stand firm for each advocate's right to be heard, and provide a rational stage for informed debate.

Environmental educators have the right and the duty to be environmentalists, but the dual roles must adhere to the original premise—to keep each hat on its proper head, while utilizing to the fullest the professional skills of the environmental educators.

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* John Hug. Reprinted from *A Report on the North American Regional Seminar on Environmental Education: A Confrontation with the Issues: Environmental Education for the Real World*. Columbus, OH: CSMEE Information Center, 1977.